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EDUCATION

Science Education Number

"Teaching the children of the Commonwealth is not just another job, but within itself has elements of sacredness."—Herndon.

THE DUTIES OF SCIENCE EDUCATORS —An Editorial

A PROFESSOR OF SCIENCE EDUCATION IN A STATE UNIVERSITY *By* G. P. CAHOON

A DIRECTOR OF SCIENCE EDUCATION IN A LARGE MUSEUM *By* W. STEPHEN THOMAS

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EDUCATION

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THE DUTIES OF SCIENCE EDUCATORS

An Editorial

THIS issue of *Education* is distinctly vocational. Science Education is rapidly becoming a specialty, with an active research program, responsible supervision, and a personnel of broad background and excellent training. Aspiring to future service in this field, students may rightly ask: "What do science educators do?"

The diverse contributors to this issue were invited to explain — most concisely — their daily duties. If some of the articles seem distinctly personal, it was by direct request. Others are written in an impersonal style, but inferences as to the activities of their authors are easily drawn.

Each contributor wrote in a proper spirit of humility. None wished to set himself up as the perfect example of a science educator—yet none apologized for his convictions as to the importance of his job.

Contributors were also asked to specify the program of training that should be followed by a young teacher who aspires to hold a similar position. It is not surprising that most of the suggestions embody qualifications of character and temperament as well as educational credits. Science teaching has always been a challenge to personality.

One most illuminating article is missing from this list — that written by a true prophet. The teaching of science is in a state of flux that perplexes even the oldest, wisest science educator as to the future. The words of experimenters are more welcome, however, than those of seers.

The most significant research in science education is probably that which coördinates science with all its contemporary subjects in a broad program of experimentation over a term of years. Two notable coöperative five-year studies of "Thirty Experimental Schools" are current examples: that of Atlantic and Great Lakes States guided by the Progressive Education Association; that of the Southeastern and Gulf States sponsored by the Southern Association of Colleges and Secondary Schools. The science curriculum is in expert hands in these investigations — but coördination in spirit and in truth must be observed.

The individual research of science teachers is not to be discouraged. In the spirit of the times, however, it is likely that coöperative efforts may bear more fruit. Science teachers should be more willing to work with their fellows in studies by their County and State organizations. Regional

science studies—hitherto few—should become numerous, significant, publication-worthy. There are national organizations of science teachers that have made few contributions as a group, although their individual members are professionally creative. Yet group consciousness and coöperation are characteristics of every true profession.

One fact stands out through this entire issue of *Education*—Science Education offers no sinecures! A complementary fact is to be caught by careful reading — there is joy in the working.

"Experience in teaching science in both elementary and secondary schools is desirable."—CAHOON.

Professor Cahoon is Associate Professor of Education and Science Education, Ohio State University, Columbus, Ohio. The many responsibilities of such a position are clearly set forth in his account of the duties assigned to

A PROFESSOR OF SCIENCE EDUCATION IN A STATE UNIVERSITY

G. P. CAHOON

EVERY worker in science education is concerned with problems relating to the experiences of boys and girls in elementary and secondary schools. While professors in colleges and universities, in this as well as other areas, have often been accused of being a long way off from such problems, their activities do have such pupil experiences as the focus. Professors of science education are essentially concerned with the problems of the nature of the experiences (including content) which boys and girls should have so as to achieve desired outcomes; with the activities of teachers in guiding these pupil experiences; and with the nature of the program and experiences desirable for teachers in such pupil guidance.

GENERAL RESPONSIBILITIES

In connection with the three main phases of school-pupil experiences toward desired outcomes, teaching activities, and the teacher-education program suggested above, a professor of science education is concerned largely with the following major activities: (a) Developing and putting into practice a program; (b) supervising and guiding teachers; (c) teaching; (d) reading, writing, and research.

PROGRAM ACTIVITIES

Before one can plan a program of teacher education in the science area he needs to have a rather clear-cut frame of reference or philosophy. The kind of experiences, courses, and education program for teachers depends upon a number of inter-related factors, such as the place of the school in society, the nature of the pupil outcomes, the kinds of pupil experiences, the rôle of teacher and pupil in planning, the relation between elementary and secondary school science education. Upon what one decides in regard to these and similar problems, depends the kinds of "training" which teachers of science in his institution will have.

It is not so difficult to plan what seems to be a desirable program; in putting it into practice, however, one

frequently encounters obstacles. There are rules, regulations, habits, established practices, mores, inertia, precedents, prejudices, policies, politics, fears, ambitions, personalities, interests, and inter-relationships which complicate getting a program under way. These may be tied up with a variety of factors in connection with the State Department of Education, the legislature, city and county school administration, teachers federations, as well as departments and colleges of the university.

SUPERVISION OF STUDENT TEACHERS

One of the experiences for prospective teachers usually considered most valuable by educators and students alike is that variously called practice teaching, student teaching, cadet teaching, or supervised teaching. This of course varies in its administration with the different institutions. In many state universities a quarter or semester of such student teaching is required. Some institutions provide a so-called training school or demonstration school where most or all of student teaching is done under the direction and guidance of selected teachers. These teachers are often called critic teachers or supervising teachers. In other institutions where no demonstration school is provided, or where it is inadequate to take care of the student teaching load, student teachers are placed in the nearby city schools, or in those of surrounding towns. In our own institution we have student teachers in three types of schools: a campus "experimental" school (University School); the public schools of the city (Columbus); and in the schools of small nearby towns or rural districts. The supervision of these student teachers is usually one of the important responsibilities of the professor of science education. At our own institution those doing student teaching in science in any one quarter have varied from about 5 to 15, with the average in recent quarters about 10. Since here, as at some other colleges and universities, the supervisor of science teaching is also the supervisor of mathematics teaching, the total number of student teachers with whom he works in a quarter varies from about 10 to 30, with an average of around 20. As these student teachers are placed in from 8 to 15 different schools, from the campus school to those from one to 25 miles away, the problem of supervision, even with an assistant, is a large one. This is especially so when each student teacher is visited or observed at least once each week by the supervisor or his assistant.

SUPERVISING TEACHERS

If the student teaching is to be most effective and functional it needs to be integrated with the other courses and experiences which the student teacher has had or is having. This means a close contact with the supervising teachers, who after all are most directly related to the guidance of the actual student teaching experience. A visit of even once a week by the supervisor — and this often is as little as once a month or less in some institutions — is too infrequent upon which to base any adequate supervision or guidance. It is usually desirable, therefore, to have rather frequent group conferences with the supervising teachers. These need to be sup-

plemented with numerous individual conferences, concerned with particular problems met by a student teacher, or with the supervising teacher's own problems.

STUDENT TEACHER CONFERENCES

It is a common practice, in most institutions, for the supervisor to have a group conference or section meeting once or twice each week. These need to be supplemented by rather frequent individual conferences between the supervisor and student teacher. In addition to the general provision for supplementary texts, pamphlet and bulletin board material, visual and other aids, the supervisor frequently needs to help in providing special material, apparatus, reference sources, or study aids in connection with each student teacher's own daily-classroom activities.

STUDENT TEACHER REPORTS AND RECOMMENDATIONS

The student teaching experience is one of the best evidences of a prospective teachers' value as a regular teacher. Hence, frequent reports on student teachers usually have to be made by the supervisor, and a final recommendation filed with the Appointments Secretary, Dean's office, or other appropriate place. Often the candidate "joins" one or more agencies outside the regular campus placement bureau, to which the supervisor is expected to write letters of recommendation. In addition, superintendents or boards of education write directly for statements concerning the teaching experience and ability of an applicant.

SUPERVISION OF PRE-STUDENT TEACHING EXPERIENCES

In a growing number of institutions it is becoming the practice to provide contact with, or participation in some phases of the actual teaching job under "field" conditions previous to student teaching. Freshmen and sophomores, for instance, may work in various schools throughout the state during the few weeks prior to the starting of University classes in the fall. Sometimes two, three or more weeks may be utilized out of a particular course when students work with teachers and pupils in regular school situations. The supervisor of science teaching, of course, may work with students in connection with this sort of experience.

IN-SERVICE SUPERVISION

Another growing tendency is that of contacting and providing guidance to teachers in the field. Unfortunately a four or five year "course" in a teacher-training institution does not provide one with all the answers or skills needed to solve the variety of problems in teaching boys and girls in science or any other area in our changing public schools. Science teachers are continually seeking help in connection with their own particular problems peculiar to a given situation. The science supervisor, if properly qualified, can provide great assistance in these in-service problems. But he has to do it in the situation where the teacher is, in the light of the particular community, the objectives of the local school, and with the personnel, pupils, equipment and resources of the

given situation — not merely by "remote control" from his campus office.

TEACHING OF METHODS COURSES

The teaching responsibilities of a professor of science education are usually associated with methods courses in the teaching of science. Sometimes these are combined into a single course concerned with science teaching in general; sometimes separate courses are given, such as the teaching of elementary science, of biology, of general science, of physics, or of chemistry; sometimes two "subjects" are combined, as the teaching of biology and general science, or of chemistry and physics. Frequently other courses related to the problems of teaching science are provided. These may be concerned with such phases as "professionalized subject matter," visual aids, sources and materials, history of science, or the use of apparatus and tools.

In a few institutions there seems to be a tendency to eliminate methods courses as separate courses, and to integrate these phases with the actual student teaching experiences or courses.

DEMONSTRATION SCHOOL TEACHING

In some state institutions the professor of science education also teaches high school classes in the demonstration school or University School. Sometimes he acts as the head of the Science Department of such school and teaches one or two high school classes, or perhaps none regularly.

GRADUATE TEACHING

In state universities where graduate work leading to the master's degree or the doctorate is provided, usually courses are offered in science education on the graduate level. These are, of course, taught by the professor of science education, and vary considerably with the institution. Among such courses in science education which might be offered are seminars, special problems, philosophy of science, supervision, teacher-training, curriculum building, evaluation, research methods, and advanced supervised teaching. Often, of course, these are related to some of the other work previously discussed, such as other courses or in-service supervision.

An important responsibility of the professor of science education in graduate work in this area as in others is that of advisor for a candidate in connection with his graduate program and particularly his thesis or dissertation. Even a small number of such thesis problems may take considerable time and energy away from such other responsibilities as supervision, teaching and individual conferences, unless the whole is carefully planned.

PROVISION FOR TEACHING AIDS

If the professor of science education is to function effectively in connection with the large variety of problems of these two main phases of supervision and of teaching, he needs to make provision for a wide variety of materials, sources, and devices which prospective teachers and graduate students may contact and utilize. These need to be at hand so that teachers and students may get experience with them, and not just hear about them. This means bringing together a wealth of visual aids, pamphlet and

bulletin board material, texts and references, demonstration and laboratory apparatus, directed study and evaluation materials. It also means working with these materials with teachers and school pupils, and keeping them continually up-to-date.

READING, WRITING, RESEARCH

For such activities as suggested above, a professor of science education obviously needs to read widely and "keep up-to-date" in a number of fields. Books, magazines, and reports concerned with new developments in science, the applications and implications of science to social and economic problems, educational philosophy, curriculum tendencies, and of course with the teaching of science, need to be contacted. If his program is to be effective, he probably needs also to base some of his planning upon the results of studies or research. He needs also to give to others the benefit of his experiences, thinking, and research by reporting these in appropriate educational journals.

TRAINING NEEDED

The foregoing discussion of the responsibilities and activities of a professor of science education suggests something of the training which is needed by such a person.

Academic Preparation

One needs first a broad background in all fields of science — physical and biological. The general science teaching major in the undergraduate work, now available in a number of universities, should serve as a good foundation. For many situations it would be desirable to have in addition a major in a particular field, as in chemistry or bacteriology. A master's degree, either in a science field, or in education, with emphasis upon science teaching or upon the elementary and secondary curriculum should follow. Either before or after the master's degree or both, one should get a few years' experience in elementary and secondary school science teaching, as suggested below.

At the present time it is almost essential for one to obtain the doctorate for teaching in a state university. For the positions under discussion the doctorate should be in education rather than in a particular science field, since we are concerned in working with boys and girls and the problem of teaching. Among the courses needed or the phases in which one should be able to show proficiency are: growth and development of children; psychology of learning; the school in a democratic society; social and economic implications of science; history and philosophy of science; statistics and research methods; scientific thinking; evaluation techniques.

Teaching Experience

Since, as has been indicated, a professor of science education is concerned with problems relating to the experiences of boys and girls in elementary and secondary schools, it is essential to get first-hand contact with these problems — and to continue to have such contact. Experience in teaching science in both elementary and secondary schools is desirable. This should be as varied as possible, to include large and small schools,

rural and urban districts, elementary, junior high school, senior high school and junior college levels, supervision and classroom teaching, and "extra-curricular" or out-of-class activities. A minimum of five years of such experience would be little enough.

Practical Experience

Somewhere, somehow, the prospective professor of science education needs to get a great deal of practical experience in a rather wide variety of skills, in addition to those to be acquired in the usual college science laboratory. If he is to guide teachers who in turn are to guide pupils in a modern program of education knowledge of and skills in such phases as the following are desirable: photography, including taking and projecting motion pictures, electrical wiring and appliances, glass blowing, metal and wood working with simple hand and power tools, gas engines, radio and public address systems. In addition he should of course be able to talk before a group effectively and easily, and to express himself in writing.

"Second to knowledge . . . is the ability to present facts in a simple and popular manner."—THOMAS.

Dr. Thomas is Director in Education for the Academy of Natural Sciences of Philadelphia. He is pioneering in a very new field as

A DIRECTOR OF SCIENCE EDUCATION IN A LARGE MUSEUM

W. STEPHEN THOMAS

TEACHERS of science are turning more and more to the museum to supplement their work in classroom and laboratory. This task the modern museum, with its exhibits, specimens, motion pictures and visual materials, is notably equipped to do. On that account, although it is a new thought to some persons, museums are centers of learning as vital as libraries, universities, and even the schools themselves. Visitors to an up-to-date natural history museum, for instance, find not only the iridescent butterfly, fossil shell-fish, or African gorilla displayed in the manner in which it lived, but they also find the means of interpreting the facts about those exhibits. They may seek their answer in labels or guide-books, but, what is more significant, they may find it in the words of the museum's educational staff, whose informal gallery talk or more formal lecture is the essence of education in a museum.

Such museum teaching is today a recognized profession, but it is a new one because only now are museums in a real position to further education. Though the field is, indeed, in its pioneer stage, it is rapidly evolving a method and standard of its own. As the public which a museum educator serves is by no means limited to school and college classes, demanding direct or supplementary knowledge, but includes as well the interpretation of information for adult persons who wish to fit it to their own occupations or hobbies, the scope of the work is exceedingly broad.

For those now in the teaching pro-

fession who would wish a glimpse of the museum's rôle in education it may be well to sketch my own duties as Director of Education in the Academy of Natural Sciences of Philadelphia, the natural history museum of the country's third largest metropolis.

My daily routine varies from the supervision and teaching of classes in the museum to the planning and promotion of future programs. It also comprises writing articles and addressing school groups, clubs and other organizations outside the building. These turn to us one day, perhaps, for an illustrated talk on some aspect of local natural history, and on the next for an account of the work of science education. Not a little time I devote to directing the educational staff of four full-time and one part-time instructors, who are engaged in teaching the numerous elementary and secondary school classes which come not only from Philadelphia and nearby suburban communities but often from points thirty or more miles away — frequently from the neighboring states of Delaware and New Jersey.

We offer to these pupils and their teachers, who journey for the most part in single classes in their school busses, a series of twelve free Museum Talks or Lessons. The subjects range from "Our Changing Earth" — which is a simple introduction to geology, and "Pre-Historic Life" — an account of the past as revealed in fossils, to "Our Furred Neighbors," "Birds," and "Insect Friends and Enemies" — studies in local natural history. The procedure for each lesson includes a meeting in a museum classroom where the museum instructor illustrates the talk with specimens, lantern slides or movies, as the case may be, followed by a guided tour of the museum exhibits, which relate to the topic under discussion. In a majority of cases the knowledge and experience acquired in the museum correlate with the school course of study in general science, biology, nature study, geography, and the social studies. In advance of the trip to the museum the teacher at her school receives a preliminary sheet, outlining the subject to be covered. This information helps her in preparing the class for their visit, and also in her follow-up teaching. During 1937 our educational department gave such instruction to a total of 38,000 pupils.

In addition to our expanding school service, we also serve adults — an ever-widening audience. Some of these persons come from churches, foreigners' naturalization classes, welfare organizations, garden clubs and a variety of other sources. They gain a fresh realization of what a museum can mean to them after a guided tour past our habitat groups of animals in their natural settings, our minerals under fluorescent light, and our reconstructions of mighty dinosaurs. Another group of some five hundred grown-ups attend our year-round program of free guided natural history field trips in city parks and nearby areas. These, "Expeditions in Philadelphia" are held on Saturday afternoons, so that business and professional people may take advantage of them in their free moments. I spent a considerable portion of my time in the organization of this service, which meets with increasing demand and is new to our metropolitan community.

Another activity of my educational

work is conducting courses of training in leadership of nature and science activities; these are offered to teachers, settlement workers, camp councillors and playground leaders. In the spring of 1938, the Academy sponsored such a course in eight evening sessions, which had a total enrollment of over forty persons. I gave, also, five survey courses in nature leadership before city and county park employees, girl scout leaders, a Y.M.C.A. youth vocational forum, and a training institute of the National Recreation Association. Our Department also concerns itself directly with recreation for boys and girls. It does this by organizing two general nature and one mineral club for children whose ages range from nine to fourteen. These groups meet in the museum on Saturday mornings and participate in discussion groups, sketching, model-making and field trips in the city parks.

In the case of my own institution, the Academy of Natural Sciences, we link our educational program closely with other museum functions. For that reason, I am a member of the Museum Exhibits Committee and have some part in the planning and improvement of displays and, also, belong to the Advisory Board of the Academy's publication, *Frontiers: A Magazine of Natural History*. This duty involves helping the editor plan educational features and the contribution of occasional articles. In addition to my outside visits to principals and teachers and the heads of organizations which we serve, I frequently represent the museum at educational and recreational meetings in other cities. In order to obtain information for conducting our own program during 1937, I visited thirty-six museums in ten different states.

It can be seen quite readily that anyone engaged in such diverse activities as a museum educational director has the opportunity for wide experiences in teaching science, as well as relations with the many types of public schools, organizations, and individuals who use our services. It gives one an unusual chance to consider reactions and to study what is needed so that we may shape our activities according to needs. As the Department of Education in our museum has been established but two years, there is constant need to experiment and make new plans. Of course, not all of these plans may work, but it is most fortunate that the very newness of our endeavors in our community makes it possible to try new features and gives us a fresh field for accomplishment.

The most important problem of my work is the responsibility of conducting a program of education which should combine the most efficiency with the greatest use to a diverse public. We are not only anxious to present our offerings as direct education, to dispense information about the world first-hand, or as supplementary material to round out the study of school and college, but also to furnish the interpretation of facts, to adapt the information we dispense to the daily life of the common man. For that reason, we do not rest content with providing what we think the school child or the mature individual should have. We also attempt to determine what they seriously desire.

Undoubtedly, there will be increasing numbers of young persons in the

future who will be interested in filling positions in museum educational work. At the present moment there are only a limited number of science museums employing directors of education. Increasing demands should open new opportunities. It can be seen that the routine academic and teaching experience fitting a person to teach in the science field is not sufficient training for the work I have outlined. First, if one is interested in the field of biology or the natural sciences in their broadest sense, it is desirable to have as wide a background in this specialty as possible. Besides a college degree, a person should have experience out-of-doors. Work as a camp nature councillor, biological field station worker, ranger-naturalist in the national parks or expedition member are all forms of employment that help toward qualifying a museum educator. Also, a candidate should have some actual training in museum work, either in research or education, preferably both. There are a number of museums throughout the country which now offer apprentice courses in museum duties in which the student learns by actually engaging in the work. Among other centers for this training are the Buffalo Museum of Science, the Newark Museum, and the University of Rochester.

Second to knowledge, but equally important in the field of museum instruction is the ability to present complex facts in a simple and popular manner. Combined with all these requisites, one needs enthusiasm and energy, essentials for any one whose occupation brings him in close touch with other human beings but particularly so in a field about which the layman knows so little as museum education.

"Teachers need to participate actively in research, however small the problem."—ZECHIEL.

Mr. Zechiel is Curriculum Assistant for Science and Mathematics of the Commission on the Relation of School and College (an activity of Progressive Education Association) with headquarters at Ohio State University, Columbus, Ohio. Because of his very responsible participation in a noteworthy study now in progress, he knows first-hand the tasks of

A COÖRDINATOR OF SCIENCE INSTRUCTION IN EXPERIMENTAL SCHOOLS

A. N. ZECHIEL

THE tasks of a coördinator of science instruction in experimental schools are closely similar to those of a science supervisor. Perhaps this statement should be qualified somewhat by stating it in the reverse order. The duties of a science supervisor are rapidly becoming broadened to include the duties of coördinator as well as supervisor.

When we speak of "coördination" of science instruction, just what are we talking about? Do we mean a unification of the science offerings in a school curriculum so that the field is adequately covered? Or do we mean coördination of science instruction with the other curriculum offerings of the school? The first concept considered is not a new one either in theory or practice. It represents a problem which has received a great deal of careful and intelligent consideration. Science supervisors, both city and state, have made valuable contributions to its solution. The second problem is also old in theory, but has been sadly neglected in practice.

Probably the outstanding trend of the present time is toward a consideration of a curriculum of secondary schools from the point of view of student experiences rather than from a consideration of content offerings within isolated fields, with sequences carefully determined on a basis of prerequisite knowledges and skills at each grade level. The latter type of organization is well illustrated by most state-wide or city-wide courses of study, and makes a very satisfactory picture of the science curriculum. However, when one examines the "credits" amassed by a representative group of seniors graduating from any of our schools, a decidedly different picture is presented. The beautiful sequence found in the paper curriculum is woefully lacking in the school experience of a large majority of our graduates.

It seems, therefore, that the task of a coördinator of science instruction should be defined in terms of a coördination of the school experience of students, not in terms of a coördination of science content. This obviously means that the science supervisor's duties, broadly conceived, have much in common with supervisors in all other fields. He must have a broad grasp of the whole field of education. It is obviously necessary that he have a high degree of competence in the science field and a background of successful science teaching experience, but that is not enough. He must be able to see his special field in relation

to all other fields and — still more important — in relation to the needs and purposes of the adolescent boy and girl as members of a democratic society.

The emphasis in the title on the term "experimental" schools implies an assumption that should be stated and its implications explored. The use of the term experimental seems to assume that *the answer* in terms of a school program has not yet been established. The coördinator then must also have the experimental attitude and must serve as advisor and consultant rather than as salesman for a predetermined program.

With this all too brief background, what, then, are the specific duties of a coördinator?

(a) He must become familiar with the philosophy, purposes and program of the school in which he works. This very often means that considerable time must be devoted in the school in aiding the entire staff to formulate their philosophy and objectives in operational terms. All too often school and departmental objectives are stated in such general terms that they do not function efficiently as guides and criteria for the selection of content or the determination of classroom procedures. An example of an objective so treated may serve for purposes of illustration.[1]

In addition to aiding the staff formulate its school objectives clearly the coördinator must then assist the science teachers in promoting specific objectives of the science instruction to insure that these specific objectives are in harmony with, and contribute to, the objectives of the school.

(b) The task next facing the science teachers and the coördinator is in formulating a program of courses and exploring the contributions of the science department to other areas of the science curriculum. Very often science can make significant contributions to social studies, mathematics, home economics, and art courses — to mention a few in which such procedures are now to be found on an experimental basis. The determination of desirable classroom procedures is also a problem needing attention. Very often the work of this group will be devoted to the formulation of teaching units and source units.[2]

1 Asa Tenney, "Science in General Education, Appleton-Century Co., 1938, pp. 480-481.

1. A student who is skilful in critical thinking
   - 1.1 Can discover and define problems (is curious, but does not try to solve problems on which there are no data).
   - 1.2 Observes accurately in the laboratory and outside it.
   - 1.3 Shows discrimination in selection of data and is reasonable in his interpretation of them.
   - 1.4 Formulates fruitful hypotheses.
   - 1.5 Reaches justifiable conclusions which do not claim too much or too little from the data.
   - 1.6 Is resourceful in attacking problems and flexible enough to criticize a line of action at any point and revise plans of procedure.
   - 1.7 Formulates and carries out a plan of action even when it must be based on inconclusive evidence and tentative judgments.
   - 1.8 Evaluates authorities, seeing through propaganda and fake advertising.

SUGGESTED CLASSROOM PROCEDURE

Planning of a great deal of the work as problems which can be solved only by laboratory work, interviews, and extensive reading. (Probably not all the class work should be so set up. Even eleventh-grade students need a rich experience in science, and problem-solving is a time-consuming process. Besides, requiring a student to track down answers to questions known by the teacher is not true to life, nor does it seem so to an adolescent.)

Frequent use of paper and pencil tests of factors of thinking. (Besides measuring progress, these tets become an excellent teaching device. See Chapter IX.)

Criticizing arguments of speakers and writers outside school.

2 H. G. McMullen, A Unit on Public Health, "Science in General Education," Appleton-Century Co., 1938, page 501.

(c) The coördinator is often called on to act as constructive critic. This criticism must always be relative to the stated philosophy and objectives of the school and not relative to a predetermined program. It is in this capacity that wide acquaintance with experimental work, and standard practices of good schools, is invaluable. Always, however, the critic must see the procedures of another school in terms of its possible contribution to the objectives of the particular school under consideration. In all cases the strong points of the existing program should be pointed out, the assets of individual teachers studied and recommendations made to utilize to the utmost any specific strength possessed by some individual teacher. For example, in a certain school unusual interest and knowledge in the field of nature study on the part of some staff member might make a course profitable and valuable in his school and yet be a total failure in another school.

(d) The fourth type of service required is that of a clearing house for all types of helpful material for which teachers are searching. Bibliographies on special topics such as conservation, consumer education, safety, health, teaching units, source units, new texts available, tests, visual aids, movies, all represent problems to the teacher. Special bibliographies must often be prepared; e.g., on philosophy of science teaching, how to develop critical thinking in students, special projects for science classes.

(e) The fifth and most important service requires the coördinator to keep up-to-date on current literature in the field. All too often teachers cannot read the mass of material coming out in print. The coördinator can function as an aid in the selection of articles and books in order to economize time for busy teachers, recommending only that material which is relative to his problem or interests. Attendance at a wide range of conventions is also important in order to keep abreast of the rapid developments in secondary education.

In brief the duty of a coördinator is in the nature of "in service" training of teachers. The job requires a love of people and the ability to contact people easily and obtain their confidence and respect. The coördinator must always work through other teachers; the opportunities for self-glorification and advancement of personal reputation are limited if one's work is to be effective. The rewards come in seeing teachers increase their efficiency and effectiveness, in seeing schools become more definite in their helping of young people in the achievement of balance and growth.

Opportunities for this type of service should be on the increase. In order for teachers to develop increasing effectiveness they should be engaged in some research problem whether their school is definitely committed to a research program or not. The nature of this research should be concerned with teaching problems rather than in advancing the frontiers of knowledge in the science field. Teachers need to participate actively in research, however small the problem, because by so doing they clarify their objectives, become critical of their own procedures, and increase their effectiveness as consumers of the research findings of other workers.

"A demand for well-trained naturalists is developing."—GREEN.

Professor Green is Head of the Department of Nature Education, Pennsylvania State College, State College, Pennsylvania. His administrative ability in both college and camp have made him outstanding as

A PROFESSOR OF NATURE EDUCATION IN A COLLEGE

GEORGE R. GREEN

NATURE Education is one of the distinctly broad fields of science. It is not interested primarily in structure and function of parts, systematic and scientific classifications, nomenclature, and the like, that characterize the narrower sciences of plant and animal life, and physical forces. To understand what Nature Education really is, it may best be defined in terms of those purposes for which it is studied, the typical courses included in it, and the activities of an instructor of the subject.

Students specializing in Nature Education may be divided into four groups, viz: (a) those preparing to teach nature education, conservation, biology, and general science in public schools; (b) those desiring a broad nature and science training to prepare them for general public educational work with such agencies as the United States and State Biological Surveys, federal and state park and recreation bureaus, federal and state fish, game and conservation departments, future farmers and 4-H clubs, and such institutions as zoos and museums; (c) those wishing to train for work with youth and recreation camps, boy scouts, girl scouts, campfire girls, etc.; (d) those taking graduate courses and research work for future service in colleges and universities.

A Department of Nature Education usually gives courses covering broad fields of instruction, of which these examples might be typical: (a) Survey of Nature — a one-year course giving an orientation of the full field of nature. (b) The Woody Plants — a study of trees and shrubs in their relation to other plants and animals, with special emphasis on their aesthetic and economic value to man. (c) Conservation — a study of the principles and laws of conservation. (d) Natural Resources. (e) Methods in Teaching Nature Education and Conservation. (f) Problems in Nature Education and Conservation. (g) The Development and History of Nature Education and Conservation. (h) Camp and Nature Counselors. (i) Fish and Game. (j) Nature and Conservation publications and literature.

The duties of a professor of nature education are primarily educational and advisory. In the administration of the department, it is necessary that he advise students relative to courses and curricula for preparation and certification for teaching in the various sciences, both biological and physical. He has to develop and outline new courses as the needs of the students and the times require. He has to keep in close contact with the public school

systems, particularly as to their offerings to nature education and the sciences. He must make speeches and addresses before various organizations interested in conservation and nature study.

A schedule of daily routine would be something like this:

(a) Teach three or four hours (three or four different courses).

(b) Confer with several students relative to their college work and curricula.

(c) Attend a meeting of a committee having to do with college policy, administration, or special problems of methods and courses.

(d) Answer numerous inquiries sent by mail to his department, referred to him by the administrative authorities.

(e) Oversee the work of graduates and graduate assistants.

(f) Supervise work of the various junior faculty members under his charge.

Probably the most important problems in this work are these:

(a) In vocational guidance — to lead students into the courses and activities for which they are best fitted.

(b) In supervision—to keep staff members alive and alert in order that their class and laboratory work may be challenging and inspirational.

(c) In professional vision — to sense in advance educational needs as expressed in teaching and certification requirements.

(d) In public relations—to arouse and stimulate in every way possible public interest in the problems of nature education, conservation, and science.

Persons wishing to prepare for college or public service in Nature Education should be well grounded in the principles of education and psychology. The development of a sound educational philosophy is essential. Relations with students will require a deep sympathy and understanding with their problems. The best contact with the general public may be maintained if the psychology of public relations is thoroughly understood. The following courses are recommended:

(a) General Education, (b) General and Educational Psychology, (c) Child Psychology, (d) Theory and Practice in Education, (e) Observation and Practice Teaching, (f) Visual and Sensory Aids, (g) Educational Measurements and Tests, (h) Vocational Guidance.

A broad understanding and knowledge in the fundamental sciences must be obtained. These must include not only the biological sciences such as botany, zoology, entomology, bacteriology, ecology and forestry, but also the physical sciences such as chemistry, physics, geology, astronomy, climatology, and geography. Some systematic courses are essential, but the greater amount of time and emphasis should be placed on field work and relationships of flora and fauna to their natural surroundings. In this field the following courses are suggested:

(a) One year of General Botany, (b) Systematic plant classification, (c) Genetics and Plant Ecology, (d) One year of vertebrate and invertebrate Zoology, (e) Classification of mammals, (f) Ornithology, (g) Limnology, (h) Entomology, (i) Animal ecology, (j) Bacteriology, (k) One

year of Chemistry, (l) One year of Physics, (m) Geology, (n) Climatology, (o) Astronomy, (p) Economic Production of Game Animals and Birds.

It would be well to spend at least one summer as a student in a Nature or Biological Camp and one or two summers in practical field work with some good conservation or biological division. It will be distinctly helpful to have special training in photography, at least to the extent of taking and developing of pictures, lantern slides and film strip, and the making of silent and sound moving picture film.

A demand for well-trained naturalists is developing, not only in the teaching profession but also in field and camp work. The attention of young people of good personality, with an obvious love of nature, may well be directed to this vocation.

"To be progressive a school need not be unconventional."—OBOURN.

Mr. Obourn has made noteworthy the science courses in the distinctive John Burroughs School, Clayton, Missouri. Although now an instructor in the School of Education, New York University, he frankly anticipates further service as

A TEACHER OF SCIENCE IN A PRIVATE-PROGRESSIVE SCHOOL

ELLSWORTH S. OBOURN

IT has been said many times about Education as a profession, that, "Those who can, do, those who can't, teach." This vicious fallacy is based on prejudiced opinion and a complete lack of understanding or sympathy for the problems concerned with the education of youth. To me there is no more challenging field of endeavor than the one associated with the guiding and shaping of the personality and behavior of young folk.

My assignment in the preparation of this paper is to give a picture of the science teacher at work in a private-progressive school. The word "progressive" has come to carry certain connotations which are unwarranted, at least in the situation about which I am writing. To be progressive a school need not be unconventional. Someone has aptly described the true progressive as "one who has his feet on the ground and his eyes on the stars." He is one who views progress as an orderly development, ever tempering the "new" with the best from the "old."

At the John Burroughs School we have tried to shape a school community that is as close to real life as we can make it. It is a place where boys and girls meet challenging problems and attempt to solve them in a free and happy atmosphere. Our school community is controlled jointly by students and faculty. Learning situations are not incidental nor are they teacher-assigned tasks. Learning is a coöperative venture and the teacher is a guide. Outcomes are sought in terms of the broad understandings essential for effective adjustment in a modern world.

In a school concerned with helping young people to better understand and

more effectively adjust to the problems of modern life, the science teacher has a unique and important function. For is not modern life bound intimately with technological causes and effects? Thus it becomes the job of such a teacher to be sensitive to the adjustment problems which young people must solve and which have science implications. This means that not only must he attempt to level the unnatural barriers between the sciences, but that he must look beyond the narrow confines of his special area and seek the social and economic implications of his teachings.

In the kind of school with which I have the privilege of being associated, the science teacher meets classes, sets up demonstrations, repairs equipment, conducts field excursions, writes reports, orders equipment, and in fact does all of the routine tasks associated with science teaching. Probably the greatest difference in his position lies in the fact that he is able to plan and try out different classroom techniques without being bound too closely by a course of study or syllabus.

At John Burroughs, as is true with many other schools both public and private, we have come to believe that it is more important for young people to grow in desirable attitudes, appreciations, and methods of thinking, than it is merely to learn the facts of biology or chemistry. This means only that subject matter is mastered not as an end in itself but as the means to the solution of challenging problems. Thus the science teacher is confronted with a most intriguing—and at times discouraging—situation. He must be alert to the problems of young people and must so shape the learning experiences that they will function in providing understanding and at the same time develop attitudes and abilities of reflective thinking.

Probably the most important aspect of teaching science in a progressive school is the working out of plans which will contribute to the outcomes briefly suggested above. First the science teacher must develop a sensitivity to the real problems of young people. He must clearly define the implications of these for his field and select materials and learning experiences which seem to have promise for the adequate solution of the problems. At the same time he must plan the development of these learning experiences so that they will provide opportunity for much practice in the elements of reflective thinking and the fostering of desirable attitudes. The real test of the plans comes, of course, in the teaching and it is often necessary to modify plans and practices in the light of the real classroom situation.

The above statements do not imply that the materials are of the bizarre and spectacular nature. It is very often the case that the most conventional and commonplace situation will offer challenging materials for solving real problems and giving abundant opportunity for practice and growth in the elements of reflective thinking. I recall with some satisfaction an unplanned series of experiences which resulted from the sensitivity to problems of a boy in a physics class. We had been studying the siphon; the principle had been explained by the use of diagrams and the applications of the principle had been demonstrated in several ways. This boy

noted that in several of the demonstrations the speed of flow of the siphon differed. He raised the question and in the course of a few moments several hypotheses had been proposed. The next two weeks were devoted to testing out these and other hypotheses in controlled experiments.

Many will say that two weeks is too long a time to spend studying so simple a principle, but it is my belief that the outcomes other than the mere understanding of the principle were the important ones. Critical-mindedness was apparent in every discussion. Students were asked to support statements with evidence. Conclusions were doubted and those who doubted set out to prove their contentions. The resourcefulness displayed by pupils in designing equipment to test one factor as a variable, while controlling all others, was amazing to the instructor. In the final discussion generalizations were reached on the basis of real evidence which had been obtained first hand. The real values were not apparent until later in the year numerous students remarked that if all of their subjects and if all of physics could be approached through such a method, the values for them would be much enhanced and learning be more vital.

How should one train for becoming a science teacher in a progressive school? I feel very sure that training for this kind of a teaching position should be no different than for any other. First it is essential that one have good preparation in several fields of science such as physics, chemistry, biology, geology, astronomy, meteorology, geography, etc. It is probably wise also to be expert in at least one of the science areas. Beyond that it would seem desirable to have preparation in the areas where science has essential implications such as economics, political science, and the other social studies. While it is very essential that a teacher have mastery of the subject matter of science, I feel that some consideration should be given to the implications of science for the other areas of human experience. The trends toward integration of the sciences on the college level seem to me to be promising for this end.

In planning a career as a science teacher I would also emphasize the need of getting all possible background in those subjects which will help in the understanding of young people. For, after all, our efforts stand or fall, are effective or ineffective, only as we are able to deal with young people as they attempt to grow in the abilities and understandings needed for effective adjustment.

". . . *the director must listen with sympathy.* . . ."—CURTIS.

Dr. Curtis is Professor of Secondary Education and the Teaching of Science, University of Michigan, Ann Arbor. His list of graduate students is most impressive, and each major teaches him something new about the responsibilities of

A DIRECTOR OF EDUCATIONAL RESEARCH IN SCIENCE

FRANCIS D. CURTIS

THE director of research in the teaching of science works chiefly with two classes of investigators: students who are candidates for advanced degrees and teachers in committees organized for an attack upon specific problems. A large majority of the members of both groups commonly fall into two classes: those without previous experience with research and those with only a sketchy and superficial acquaintance with it.

The naive beginner is likely to approach research with awe and trepidation. He envisions it as something abstruse, appallingly difficult, and entirely foreign to all his previous training and experience. In contrast with him, the worker who knows only a little about research is not unlikely to regard an investigation as merely a formidable hurdle to be surmounted—a foolish requirement the fulfillment of which imposes an unreasonable burden of monotonous busywork. The worker, even among the candidates for the degree of Doctor of Philosophy, who approaches his investigation with enthusiasm based upon an intrinsic interest in the problem itself and in investigational procedures as means of achieving a solution, is all too rare.

The most important problems of the research director, therefore, center about his efforts to establish in the beginner a confidence in his ability to learn to "do research," and to convince the blasé and skeptical worker that research, crude and inconsequential as much of it admittedly still is, is nevertheless the only means by which a science of education can ultimately become established.

The director of research in the teaching of science must accomplish his tasks by his instruction in a seminar and by conferences with students and committees engaging in individual and group studies. The principal objectives of the seminar may appropriately include these:

(a) To present to the student an adequate survey of reported research in the teaching of science from its beginnings about three decades ago.

(b) To help the student to formulate adequate and practical criteria by which to evaluate reported investigations of various kinds.

(c) To develop in the student the ability to select a problem, to plan and carry out the appropriate steps of technique necessary in its investigation, and to report it in acceptable written form.

These objectives may be achieved through intensive group study based upon step-by-step analyses of reports of research. These analyses, conducted in the seminar by the director, with increasing student participation as the latter gain experience and facil-

ity, should effect a clear and definite understanding of what constitutes a research investigation, a knowledge of what the commoner types of research investigations in the teaching of science are, and a familiarity with the investigational procedures employed in such studies. They should develop the ability to judge the appropriateness and adequacy of techniques employed, the clearness and effectiveness with which the data are presented, and the pertinence and soundness of findings and conclusions as stated.

Ideally the student brings to the seminar some knowledge of statistical procedures; usually, however, few possess this fundamental background to an extent which enables them to recognize or to apply the techniques in actual investigational situations. It is therefore a practical necessity for the director of the seminar to include in his assignments and discussions as much of this indispensable groundwork as the students may prove to need.

To the maximum extent possible, the work in the seminar should be integrated and correlated with individual and group conference. Such a conference is successful to the extent to which it contributes to the development in each investigator of the ability and confidence to carry his investigation to a successful conclusion. To achieve these objectives the director must be willing to help the beginner to find and select his problem; it is unreasonable to assume that every researcher should be able to find a problem without help. Only a few can do this. The director of the research must therefore have in mind a considerable number of practicable problems of several kinds, which are appropriate for investigation by those whom he must direct. These categories of problems should include new and original studies which the director would himself like to investigate if his time and energies permitted; problems which have already been investigated more or less extensively, but of which the reported solutions appear unconvincing because of inappropriateness or crudeness of techniques employed; and problems which are so extensive as to be impossible of investigation by a single individual, but which can be solved to a practical extent through combining the findings obtained by many workers, each of whom has completed one relatively small part of the great problem. Examples of this last type of problem are the group of studies of scientific principles directed by Downing at Chicago and the group of investigations of scientific attitudes instituted by Robertson and still in progress of investigation at Colorado State College of Education.

In his conferences with investigators who have succeeded with or without help in selecting a problem, the director must listen with sympathy and encouragement to such plans of procedure as the student may have formed; he must indicate tactfully and with logical justification which of the proposed steps are impracticable or unsound in view of the facilities and resources available to the investigator; he must direct attention to the points at which the researcher should attempt to improve his plans and techniques; and he should suggest specific references likely to prove stimulative and

helpful in post-conference study. A conference is successful only if, at its termination, the enthusiasm of the investigator for attacking his problem is unimpaired or has been heightened; and if his confidence in his ability to proceed has been established or strengthened by his having gained a clearer understanding of possible and appropriate directions in which he may proceed. These statements do not imply that the director should plan each step and teach the student exactly how to carry it out; but it does imply his obligation to provide every investigator, however inexperienced or advanced he may be, with such stimulation, encouragement, and help as he may need in order to progress to a successful completion of his study.

There is a growing demand in universities, colleges, and large school systems for teachers qualified to direct research in the teaching of science. The young teacher who aspires to such a position must acquire:

First, a thorough orientation in the entire field of education so that his subsequent work in his specialized field may bear a logical and effective relationship to education as a whole.

Second, a practical and thorough knowledge of statistical and experimental techniques and procedures.

Third, a mastery in all that the word implies of research in the teaching of science—its history, scope, and trends.

Fourth, experience in carrying on research, evidenced by the successful completion and reporting of at least one major investigation.

"First, you must like the job . . . but you must also be qualified for the job."—THONE.

Dr. Thone is Editor in Biology for *Science Service* of Washington, D. C. He is at once a scientist, teacher, and reporter, and few indeed could better describe the daily do's and dont's of

A SCIENCE POPULARIZER

FRANK THONE

SCIENCE, like history, is something that keeps on happening all the time. No textbook or course of lectures can possibly be anything but out of date, no matter how recently revised. Formal instruction is highly useful in starting the student off and giving him the necessary standard background of information "up to now." But if he is to be an alert citizen of the world he must go on from there, largely by himself, adding information and revising viewpoints in the light of day-by-day developments. This lifelong continuation course must be obtained principally from the daily and periodical press; the trained science interpreter fulfils a function comparable to that of the reporter and commentator on political events and current history,

The daily job of the science popularizer (taking the present writer as a fair sample) is a considerably varied affair. Once in a while it is exciting, always it is crowded. Routine: Hang

up your hat,[1] uncover the typewriter, look at the assignment book to see what "must" items are on the list for today. If any of them can be executed without phone calls or interviews, go ahead and write them.

By now the mail is in. Look through that; slip a cylinder into the dictating machine and answer such letters as need immediate attention. Perhaps there will be communications, wires, "handouts," journal articles, that will serve as foundations for news items that must go today. Write them. Perhaps further information will be needed on some of these things; get phone calls, telegrams, letters on the way. Many of your items will need checking for accuracy; more phone calls and letters.

There will be consultations with fellow staff members, on stories requiring collaboration; visitors will come in, frequently bearing news values which they themselves do not suspect; requests for information will break in by telephone; proof pages will demand immediate reading. When time can be found during the day there will be longer articles to write for Sunday feature pages, for magazines; snatches at a book you're always hoping to finish — some day. Somewhere a lull, long enough for lunch. At the end, cover the typewriter, put on your hat.[1] "Thirty."

Periodically, there are science meetings to attend. If in Washington, one tucks them in around the edges of the daily job. If away from the city, one goes where they are, filing condensed reports of the proceedings by press wire. But before the meeting starts, abstracts or copies of most of the papers are available, on which one builds as complete reports of the meeting as possible, giving each day's batch its appropriate release date. This makes possible much fuller reporting than could be done by wire alone.

Besides all this, there are radio talks, consultations with educational organizations, World's Fair exhibitors, foundations, and so on, seeking or offering ideas, as well as occasional lectures and talks.

All round, it is a pretty lively life. Daily problems are concerned mainly with three things: be sure you catch the really important stories; make the best possible selections from the mass of interesting but not imperative "number two" items; avoid inaccuracies and blunders that constantly beset the path of him who has to work rapidly. Larger problems are those of the whole philosophy of science popularization: meet the challenge of the essentially snobbish cloistered souls among scientists who think that the secrets of their priesthood should not be exposed to the vulgar multitude; at the same time, resist pressure, subtle or gross, to "jazz it up" and get wider distribution—perhaps of a product so debased as to be no longer worth distributing.

The field is expanding, steadily even if not rapidly. More science "copy" is being used in magazines, more science broadcasts on the radio. More newspapers are adding science reporters and editors to their staffs. Qualifications are somewhat similar to those for success in teaching. First, you must like the job, even to the

1 The young man could save time by not wearing a hat.—Editor.

point of being imbued with missionary zeal. But you must also be qualified for the job, and that means two things: you must know what you are going to write about, and you must know how to write. You can learn a good part of what to write about in college and from life; but knowing how to express it can only be partly learned; the rest you have to be born with.

"[The teacher] should not become so interested in science material that he is unwilling to educate himself to understand young men and women."—CHRISTY.

Dr. Christy heads the Department of Science in Ball State Teachers College, Muncie, Indiana. He proves that among all teachers no one is busier than

A PROFESSOR OF BIOLOGY IN A TEACHERS COLLEGE

OTTO B. CHRISTY

A SCIENTIFC study of the activities and responsibilities of many teachers of biology would reveal a great variance in duties, but there would be a number of common elements in their activities. It will be the purpose of this article to relate some of the activities and responsibilities in one situation — my own — which may or may not be typical of others.

In general, the author considers that his chief duty as professor of biology is to provide as rich and meaningful experiences as he can for students, giving them the best opportunity possible to prepare for their chosen profession — the teaching of science and related subjects. In addition to this, he is asked to provide science experiences for "pre-medics," nurses, and liberal arts students. These must involve broad enough activities in the field of science so that the student has a fairly adequate background for the work which he is planning to do. This means that with a small staff, a biology teacher must teach a great variety of courses. In the case of the author, he usually has four class assignments per day for three twelve-week quarters and two double class assignments for at least one five-week summer term during the year. Often no two of these courses are the same in any one term or year, which means the planning of a variety of experiences for and with the students each quarter. No previous teaching or courses or planning of syllabi can substitute for this because new students present new problems.

This has resulted in the author's teaching of seventeen different courses, as well as arranging reference work in the college library for them. They have consisted of two courses in general biology for majors and pre-medics, two courses in general biology for students on the elementary curriculum, one course of each of the following: local flora, local fauna, plant morphology, ecology, forestry, entomology, bacteriology, ornithology, ornamental plants, principles of laboratory technique, biology of the vertebrates, genetics, and methods of teaching biology in the high school. The breadth of experience and background for effectively teaching all these courses

is almost impossible in the span of one short human life. Fortunately through the growth and development of the biology division of the science department this situation has been relieved by additional instructors.

Next, in importance to the actual teaching is the responsibility of being head of the science department. The duties of this job are: arranging a schedule of classes for the five divisions of the science department, biology, chemistry, geography and geology, physiology and health, and physics; the preparation or editing of catalogue statements for all science courses listed in the catalogue; the preparation and execution of the budget with the aid of representatives from the various divisions of science; and counseling with major students as to choice of subjects.

The teachers college where the author works has the policy of carrying on much of its work through committees. It is the writer's privilege to serve on the curriculum and graduate council committees, each of which has several sub-committees. In addition the writer is a member of student committees as sponsor of various organizations, such as the Junior Class, Biology Club, Skeleton Club, and Sigma Zeta.

Another major responsibility is that of planning and directing the Arboretum and college gardens. This college is fortunate in having an area of eighteen acres adjoining the campus which is used as a biological laboratory. The development of this area for the use of students has covered a period of fifteen years. The work was done mainly under the author's supervision by employing students at times when convenient for them. Almost daily it is necessary to make trips to the gardens to supervise the work of planting, cultivating, propagating, pruning, spraying, and fertilizing. N. Y. A. students continue to help with this work. At present twelve to sixteen of these are assigned to the science department each month to work from thirty to forty hours. The most of these students work in the arboretum, although some are assigned to work in the laboratories. All these must be directed in their work and monthly reports of their time approved.

During certain seasons many science classes are taken across the campus and into the Arboretum and gardens to study trees, shrubs, roses, peonies, iris, and many other plants. During the blooming season dozens of calls come to the writer for flowers to be used for college luncheons, parties, convocations, or for some faculty member. Frequent requests come from groups of students in the public schools and in the college for the privilege of going through the grounds. These are always pleasant experiences if the writer can conveniently accompany them.

The biologist receives many invitations to serve the organizations and clubs of this community, because of the interest of citizens in the fields of biological science. There are talks to be prepared for garden clubs, nature clubs, luncheon clubs, and educational meetings. Space for this article will not permit discussing such activities as attendance and participation in pro-

fessional organizations, and meeting the social and religious obligations of a college neighborhood.

As a result of years of experience as a teacher of biology in a teachers' college, the following characteristics of an individual who has ambition to enter this field of science education seem essential. Begin with a well-adjusted, intelligent person, willing to work with others. He should have broad training in the field of biology and related science. He should build his training in relation to the scientific needs and interests of a democratic society. He should not become so interested in science material that he is unwilling to educate himself to understand young men and women and how to direct their learning. He should enjoy working with students, for they are not merely studying science, but they are learning much by associating with their fellows, and are developing character through the precepts and examples of their teachers.

"When the majority of our citizens have learned the processes and formed the habit of governing their thoughts and acts by scientific reasoning, then many of the ills of society will vanish."—WARNER.

Dr. Warner, teacher of physics in the Woodrow Wilson Junior College, Chicago, Illinois, is better known as the veteran editor of *School Science and Mathematics*. No one could better describe the work of

THE EDITOR OF A SCIENCE JOURNAL FOR TEACHERS

GLEN W. WARNER

ONLY a few years ago science was clothed in mystery. Scientists worked in secrecy, poverty and gloom. The ordinary man knew almost nothing of science and feared what he did know. Today science is the dispeller of doubt and fear, the swift sleuth detecting and tracking down crime, the faithful servant performing the drudgery of shop and home, the winged messenger carrying the news of the world with the speed of light, the angel of mercy alleviating suffering and pain, the pathfinder for the march of civilization. Great discoveries in science are followed by changes in thought, economics, politics, diplomacy and religion.

To promote the continuous progress of science, scientific journals are established. Each journal has its own specific aim: one fosters research, another discusses the applications of science to the problems of manufacturing or of commerce, a third carries the principles and uses of science directly to the public, a fourth aims to make science function in the work of the schools, and so on. This article is concerned with the journal whose aim is to extend and improve the teaching of science in the schools.

A journal devoted to science education has a unique opportunity and a profound responsibility. When the majority of our citizens have learned the processes and formed the habit of governing their thoughts and acts by scientific reasoning, then many of the ills of society will vanish. A journal for science teachers that gives practical assistance in the daily work of the

school has a mission surpassed by none and equalled by few. It is worthy of the best minds, requires the most diligent application, and offers unparalleled opportunity for service. It is the business of such a journal to glean the findings of subject matter research workers and translate them into language teachers can understand and use in the classroom. The methods by means of which fundamental truths are discovered are of no less importance and often are more essential in the process of education than the truths themselves. Such a journal must present new teaching methods, find and distribute special techniques for teaching difficult subject matter, and promote programs for testing the results of teaching.

These aims demand that the editor of the journal and his staff members have breadth of experience and training. High specialization in a limited field is not sufficient. The editor must be able to grasp the significance of new discoveries in all science fields. He must understand the inter-relations of the various fields of science. He must know where investigations are in progress and who the investigators are. The incessant change in these investigations demands a continuous process of seeing what is going on in the educational and in the scientific worlds. These attributes and activities are necessary factors in the preparation and daily self-discipline of an editor who hopes to succeed, but they are not alone sufficient. Knowledge and practical use of English — spelling, punctuation, sentence structure, effective composition — are also essentials of routine and are so accepted without argument.

At his daily job the editor seeks first to determine trends in science education as the paths are blazed by the research leaders. Next he tries to find out what teachers want and need to enable them to keep up with the steady progress of research in both subject matter and educational procedure. Finally he attempts to supply these demands by inducing those who know things or who do things well to tell others about their work through the columns of his journal. In order to accomplish his ends he visits schools, colleges, classrooms, laboratories, exhibits and museums; he attends and takes part in conferences and conventions; he talks with teachers and students; he reads other related journals and new books; he carries on a large correspondence; he invites specific articles and studies many others voluntarily submitted for publication, and from all these selects those that fit best into his program. Then comes the routine of editing and preparing the manuscripts for the printer, and finally making up the journal in finished form.

These major duties must be carried out in coöperation with the business management, because educational magazines are not supplied with unlimited funds. The format of the magazine, its general appearance, embellishment, typography, paper stock, and even the subject matter, must often be a compromise between what the editorial staff would like to produce and what financial conditions will permit. Some knowledge of the commercial world, of the printing industry, of drawing, photography, and engraving are valu-

able to one who aspires to an editorial position.

Minor duties are a multitude. Like the teacher, the editor is supposed to be a fount of all knowledge and a benevolent assistant in all educational enterprises. He who would be a successful editor of an educational journal must be willing to sacrifice his own ambitions for investigation and authorship in order to help others study, teach and write. He must work early and late, not just when he feels inspired, but as his publication program demands (frequently modified and deranged by delays and errors not under his control). He must think of his work continually and interview people when they are available, be it Sunday, a holiday, or any other time. He must have a broad education, a sincerity of purpose, a firm belief in the value of an education in science for everyone, and a will and energy to work. His aim is a worthy product — one that will have both immediate and lasting value. His salary will not make him a prince in the financial world, but his job is worth doing, and brings rewards not measured in dollars and cents. In this respect he has fellowship with teachers everywhere.

"Teaching the children of the Commonwealth is not just another job, but within itself has elements of sacredness."—HERNDON.

Dr. Herndon is Professor of Chemistry in the Eastern Kentucky State Teachers College, Richmond, Kentucky. The philosophy that good teaching is his chief duty has marked his career as

A PROFESSOR OF CHEMISTRY IN A TEACHERS COLLEGE

THOMAS CORWIN HERNDON

ONCE, in response to a questionnaire concerning the administration of chemistry in his institution, the president of a teachers college in an eastern state replied, "Why teach chemistry in a teachers college? *We don't.*" Why, indeed? The graduates of teachers colleges are instructing the majority of the youth of the nation. Nearly everything we touch or eat or smell or listen to or look at is the product of either natural or synthetic chemical processes. We might better ask how could a branch of human knowledge of such manifest importance possibly be left out of the curriculum of a teachers college!

The activities of a professor of chemistry in a teachers college are different in certain respects from those of a like professor in a liberal arts college. These differences will become apparent, by implication if not by direct statement, in the subsequent paragraphs.

First and foremost among the duties and activities of a professor of chemistry in a teachers college is teaching. He teaches in the classroom and teaches in the laboratory. There is teaching also in the office and in the corridors, because chemistry students have a habit of working overtime and of dropping in at odd moments for consultations on all kinds of problems. And to be successful this cannot be

ordinary teaching in the sense of a recently given definition — "the passage of the contents of the professor's notebook into that of the student without entering into the consciousness of either." There must be more than the indoctrination of chemical facts and principles. Teaching in a teachers college must have that bit of finesse which will enable the student to do a more complete and artistic job when he graduates and starts on his own professional career.

Many materials for use in lectures, demonstrations and the laboratory must be prepared and tested. Often apparatus must be designed and assembled, and the composition and purity of a number of chemicals must be tested by analysis. Thus the teaching and all that goes with it is the really big job of a professor of chemistry in a teachers college.

Other duties that fall to him are making or revising syllabi for courses, selecting new books for the library, preparing and giving tests and examinations, and grading the appropriate number of tests, examinations, written exercises and laboratory reports.

Conferences with students fall into several classes. Counselling those who are weak and about to fall by the wayside, trying to help them to a better understanding of the subject and its relationship to their general training in general is perhaps the most important. Some are advised to go the limit in the field of chemistry, but to others it is suggested that they gracefully withdraw into some other field. Many students seek the professor's advice on securing scholarships in graduate schools, admission to professional schools, getting teaching positions, and — to a minor extent —positions in industry. These latter functions lead to another, that of writing numerous letters of recommendation.

In addition to the activities already listed, there are others of a semi-professional character. A professor of chemistry in a state institution is requested several times each year to analyze (gratis) anything from a funny-looking rock to salad dressing that doesn't stay dressed. Some of these services are rendered but others are refused especially if a legal question is involved. Also, by virtue (or is it a virtue?) of being a college professor, the teacher of chemistry is supposed to possess wisdom, and he is called upon from time to time to make a speech — if he is a long way from home it is an address by an expert.

The foregoing may be termed routine activities, but there are others of consequence in which he participates. One of these is the organization and development of new courses of instruction to meet new conditions and changing needs. Another is the sponsorship of a Science Club, which after many discouragements and disappointments should function smoothly and make some contribution to student life on the campus. Writing an occasional journal article and doing some tiny bit of chemical research are other odd-time activities.

In the performance of the duties of a professor of chemistry certain problems arise perennially. One of these is to obtain a substantial understanding of the background, domestic as well as academic, of his students. These come to the college from almost all socio-economic classes save the very lowest. Some are from homes of

wealth, education and culture; others have known the most primitive living. Some are graduates of excellent high schools with superior facilities for the study of science; others come from small, poorly equipped and inadequately staffed schools. When these widely differing degrees of preparation, ability and personality are grouped together, it takes a lot of careful study to bring out anything like the best efforts of each individual.

Presentation of subject matter in such a manner that students will know better how to pass it on is a problem that challenges one's best efforts. The student must be led to extensive participation in classroom discussion if he is to be successful later on in presenting the elements of the science in his own classroom.

Provision for the superior students presents an important problem. The writer handles this to some extent by means of additional laboratory assignments chosen by the student according to his own field interests, by more comprehensive classroom reports, by assisting in the laboratory.

Still another problem which, like the poor, is always with us is trying to stretch a none-too-large appropriation to cover the needs of a growing number of students for laboratory equipment and supplies.

These are some of the problems which the teacher of chemistry in a teachers college must face. They are not insoluble; rather they are challenges to be met and mastered.

To the young teacher seeking future service in positions such as mine, I should like to speak a word as to his training. Get a thorough knowledge of chemistry. Study mathematics and physics to a considerable extent. Familiarize yourself liberally with the humanities. This program will involve graduate work, some of which should be taken in a teachers college. Cultivate a benevolent philosophy of life and of education. Never forget that you plan to teach younger teachers, who in turn will instruct other generations of children; you are *not* training men to build and operate inanimate machines.

Develop within yourself a true professional spirit. Accept without reservation the truth that teaching the children of the Commonwealth is not just another job, but within itself has elements of sacredness.

"The most important phase of my work is that done as an advisor of students [in] individual conference."—REYNOLDS.

Dr. Reynolds, on the staff of East Carolina Teachers College, Greenville, North Carolina, possesses the knowledge given alike by research and practice concerning the activities of

A PROFESSOR OF GENERALIZED SCIENCE IN A TEACHERS COLLEGE

CHARLES W. REYNOLDS

THE teacher of generalized science has a very diversified program. He cannot settle down to the tranquility of some one phase of science teaching. He is deprived of that peace and security afforded technical scientists by those fundamental principles established by Boyle, Avogadro, Newton, and others, which have withstood the test of time. He must come out in the open and teach science — not just chemistry or physics — in its natural setting, the way in which it is experienced in life.

The program of studies for the Science Division at East Carolina Teachers College was formulated for the purpose of training teachers of science, not scientists. In order to realize that objective, the prospective science teachers are required to take fundamental courses in the three major science fields: biology, chemistry, and physics. They elect other courses in science according to their interests. In addition to the science requirements, science majors must offer for graduation a certain amount of work in education, part of which is a course in the teaching of science.

During the students' senior year, they spend sixty hours in observation and directed teaching in each of their two major fields of study. This teaching is done in the city high school under the direct supervision of regular high school teachers and the college adviser.

My routine duties in the development of this program of training science teachers are as follows: the teaching of general physics, household physics, general physical science, descriptive astronomy, methods in the teaching of science; serving as departmental adviser for science practice teachers.

The most important phase of my work is that done as an advisor of students. Each practice teacher is observed weekly and given an hour of individual conference immediately after the observation.

The conference period is devoted to a general discussion of those problems which the student encounters in his teaching experience. The student teacher comes to the departmental adviser with a varied assortment of problems. The most prevalent ones are those concerning discipline, organization of subject matter, and techniques of presenting that subject matter effectively. However, the question of broader experience in course material is frequently the major issue. The conference period is often devoted to the teaching of subject matter which he failed to receive in his previous

training, but which he now finds necessary to understand and present.

My program offers excellent opportunities to follow the development of a teacher from the early classroom training to the actual performance in normal teaching situations. By having this direct connection with students in actual service, I can check the science program of our college as to how well it may be applied by students in their teaching. My own classroom procedures in generalized science can then be modified in terms of student needs and interests. Any new plans or techniques which I desire to try may be followed through the college classroom to the field.

The training of the generalized science teacher should be broad. He needs basic training in the subject matter of the fundamental sciences: biology, chemistry, and physics. However, this knowledge of subject matter is not of itself sufficient. Courses in the application of scientific principles in an integrated form are of paramount importance for in the future more science is to be taught as an integrated field, and less as isolated fields. The science teacher should have much knowledge of the psychology of learning from which the modern principles of educational methods are derived.

Such a training will prepare the general science teacher to present science as a complete configuration. To make science meaningful, it must be presented in its natural setting. For example, in teaching the principle of the storage battery, there is something more than the principles of chemistry and physics involved. It is of more interest to the child to know what a battery can do than how it is made.

The generalized science teacher should therefore have that broad training in the subject matter of the sciences which, together with a knowledge of the psychology of learning, will enable him to lead the child into a wholesome relationship with his environment.

"Science . . . is essentially a field in which theory is made practical by experience."
—EDWARDS.

Mr. Edwards is Head of the Science Department, Joe Brown Junior High School, Atlanta, Georgia. Mr. Busbee is Director of Visual Education for the State of Georgia. The alertness of these two gentlemen set a model for city and state service by

A DIRECTOR OF VISUAL EDUCATION IN SCIENCE

KENNETH B. EDWARDS *and* H. S. BUSBEE

THE functions and activities of a director of Visual Education in the field of science comprise selection of material, training in the principles of audio-visual projection, training in the technique of audio-visual instruction, and the business of diffusing and integrating the information taught.

To begin with, a director will have brought to his attention a great deal of material some of which is scientific and well organized, more of which is pseudo-scientific and poorly organized,

and a considerable amount of which is outright propaganda with only the barest smattering of scientific information in it. He must first of all be intimately familiar with these implications in order to be able to choose what material can be used and to eliminate that which is unsuitable. After this is done he has the problem of adapting to his curriculum in orderly form, that material which is basically sound, and in this process an additional amount will be rejected. A director must count on putting a great deal of time in the quiet, unhurried, uninterrupted study of material; there is no escape from this burden.

Many times it is further necessary to test one's own opinions about materials against the background of a class or a group reaction. Sometimes students, sometimes other teachers are the reactors. One of the most useful things that can be done toward integrating visual material into regular class use is to cut out and reassemble various parts of motion pictures; or, if they may not be rearranged, chart the parts that may be used effectively in a given lesson. Then a small nucleus of people, preferably teachers of science and at least one responsible student for each teacher, should be trained in those principles of projection and the application of sound to teaching which will psychologically give the best results. This training includes such matters as the best light to use, the length of programs, maximum and minimum tone, when to cut sound from the picture and interpolate the lecturer's voice, the type of subject matter best presented silent and that best presented with sound. Much of the success of the use of film in good class work and audio-visual instruction comes from rigid adherence to these well established principles. A good electric-mechanical service background for all projection, and the coöperation of the industrial art teachers should be enlisted to train and retrain until an adequate group is available to supply each classroom with a projection crew of ample skill.

When the Science Department is a center for audio-visual materials in a large system, there is a problem of distribution and scheduling, which means that the need of each teacher in terms of standard curriculum must be anticipated, sometimes several weeks ahead. Not only must the material be on hand when needed, but the using teacher needs an opportunity to preview and assimilate it. Short conferences with the teaching group will enable the central office to provide the type of material desired, and to come to agreement as to the best types of outline that can be prepared for common use. Such committees will also bring out various suggestions which each group may use to an advantage.

While looking at the immediate task of applying motion pictures, lantern slides, film slides, etc., to the classroom teaching of a specific science, the leader of such a group will not neglect his opportunity to enhance the interest and enthusiasm of both students and teachers in general knowledge of science. It has been said that ship building comprises every known mechanical trade; the chemical industry requires first-class physicists to design its machinery. The field of outlets for services of a technically trained person is fre-

quently much greater than a student realizes. It is well to call to the attention of students the many ranges of work in which their skills may be of service. In a certain instance a list of five normal outlets of employment was increased to twenty-eight merely through organized presentation of such opportunities.

If there is one quality more than another which should be emphasized in visual education it is that effort should be bent to the development of alertness and the cultivation of resourcefulness of applying a student's basic training to work opportunities. Visual and audible impressions stick in the memory and are recalled long after the basic statement is forgotten. These, like the poet's remark about "words better left unsaid" return later "when we think them dead" and in their return they recall to the mind opportunities which might otherwise be submerged or neglected in the routine of study of apparent unrelated principles in the classroom.

Young teachers who expect to become experts in audio-visual education should not only have their basic training worked out in science itself, but in addition should carry a thorough grounding in applied electricity, and the principles and applications of sound. They should acquire a familiarity with the apparatus which is the medium for their applications to technique, and study the human psychology upon which sound and sight impinge.

The culminating activity of the director of visual education in science should be the instillation of a sincere desire in the heart of each student to develop a scientific attitude. The requisites of a scientific attitude are well outlined in *A Suggested Basis of Orientation for Science Instruction, Eighth Grade, Junior High Schools.* The statement (page 2, item 5) is:[1]

> Encouraging a scientific attitude toward life problems in which an individual:
>
> a. holds conclusions tentatively;
> b. is precise, accurate, and orderly;
> c. is free from superstition;
> d. respects the experimental method;
> e. seeks facts, explanations, and causes;
> f. is willing to entertain new ideas and points of view;
> g. bases judgment on facts;
> h. welcomes and considers suggestions;
> i. accepts the implications of interdependence.

Finally, it should be the ultimate purpose of the science teacher, making use of audio-visual aids, to instill in the mind of each student that these aids are used as a means to an end. They should learn that science is a method by which problems are solved, and is essentially a field in which theory is made practical by experience.

1 Bulletin No. 2, Junior High School Science (1938). One of a series of curriculum studies by Atlanta Junior High School science teachers. 51 pp., mimeographed, bound.

"The critic teacher must be first and foremost a good teacher of boys and girls."—BILLIG.

Dr. Billig is Associate Professor of Science Education in Wayne University, Detroit, Michigan. Young science teachers come to her classroom, and she goes to theirs. How theory is thus tested by practice is well reported in these activities of

A CRITIC TEACHER OF SCIENCE

FLORENCE G. BILLIG

PRACTICE teaching holds a unique place in the professional education of prospective teachers in the field of science. It provides opportunities for using—in real situations and under the guidance of expert teachers—the philosophy, psychology, and elements of academic and professional work that form a part of the collegiate preparation of the student. It is the function of the critic or directing teacher to help the student analyze, synthesize, and interpret this training in terms of the needs of boys and girls in their everyday living in a complex, constantly changing society. At the same time, it is necessary to help the student look forward to possible future needs, in so far as trends are indicated in the various educational and social aspects of living in a democracy.

In teaching, as in any of the other learned professions, the directing teacher needs an extensive background of knowledge as well as specific training in the particular field of work. Knowledge is indispensable, but its intelligent and purposeful use determines its effectiveness in teaching. Skill in applying this knowledge, ability in acquiring various classroom techniques, and aptitude in forming desirable attitudes toward teaching can be developed best through experiences with children in natural situations. The results, however, are enhanced when the teaching is carried on in coöperation with an instructor who is able to show by example the methods which much experience has developed and proved good.

The activities of a critic teacher in science are directed first to boys and girls as active participating members of society, and secondly to prospective teachers in preparation for their future work. To function satisfactorily in this dual rôle, it is necessary that the critic teacher be first and foremost a good teacher of boys and girls, for the same types of skills required to teach them successfully are essential in directing student teachers in their learning activities. It is necessary in science teaching, as in other teaching fields, that the critic teacher should be the kind of person who knows, understands, and enjoys people; who works easily and intelligently with them; who has a fundamental understanding of the society in which she lives; who is a good citizen and a patriot; and one who understands and appreciates the implications of education in living.

The critic teacher of science, then, has the same general responsibilities as a critic teacher in any field. In addition, the science critic has specific activities and responsibilities, some of

which may be summed up in the following way:

To understand the organization of a science program and its place in developing the objectives of general education.

To know the science resources of the community and how to use them in teaching situations, such as museums; libraries, zoological parks and gardens; woods, swamps, lakes, and streams as natural habitats of plants and animals; and various types of industrial situations that offer science experiences.

To know the common science experiences of children that are likely to arise in daily living and that provide opportunities for classroom activities of various kinds. For example, an important problem was set when a second grade child came to school on a cold morning in winter and asked, "What did the radio reporter mean when he said that it was eight degrees above zero this morning?" The solution of this problem involved activities with thermometers and first-hand experiences with an instrument that is important in social and industrial life. With such a setting, the study of the thermometer was no longer an isolated one but a part of science that related to the immediate interests and associations of children in their community.

To have skill in arranging learning situations in science for children and for student teachers, so that they contain elements common in life situations, and so that they provide opportunities for doing things that are worthwhile in living. Such learning situations provide possibilities for creating, manipulating, taking field trips, making aquaria and terraria as homes of plants and animals, and the like.

To know how to evaluate results of teaching science on the level of student teachers as well as on the level of children, and to know how to use such results in improving the work on both levels.

To know the qualities that are inherent in successful teaching of science and through sympathetic understanding, and to help others develop such characteristics. This involves ability to isolate particular needs of students and ability to assist students according to their specific needs.

To know how to help students guide individual pupils in the science experiences, regardless of whether the pupils are in large or small classes.

To lead student teachers to enjoy science; to guide them so that they will develop a feeling of pride in science teaching as a profession; and to help create a desire to continue growing in their chosen field of work.

To provide situations that contain fundamental routine factors relating to science that are essentially the same as those to be found in future service. These factors relate to the responsibilities of science teachers to the school system in which they will work; to the particular school in which they will work; and to the room in which they will work. In relation to the school system, health may be used as an illustration of such relationships. It is necessary that the prospective teacher become acquainted with the general educational policies concerned with healthful living in school, home, and community; with professional health organizations, and with various community health needs. It is a responsibility of the science teacher to guide children in developing proper health habits, health understandings, and a health consciousness toward themselves, their associates, and to the community, to the end that they will observe willingly personal health regulations, even those relating to isolation and sanitation. In relation to the particular school, the student in training should become acquainted with the responsibilities of a science teacher that relate to accurate records, safety regulations, general health and

sanitary organization, and to participation in social life as a functional agency in the community. In relation to the science room, the student should know what may be expected in the way of functional arrangement, good housekeeping, and general care of laboratory, equipment, and supplies.

The activities and responsibilities of a critic or directing teacher of science are therefore many. They require a person with a thorough background in the field of science with its implications in daily living; with ability and professional training that are essential to efficient service in public schools; with leadership that is essential in the guidance of prospective teachers in preparation for their future work; with a sympathetic understanding of the way people think and act; and with a functional understanding of education in relation to life in a constantly changing economic and social environment in a democracy.

"The Science Club is a high school fixture. A science teacher's success or failure may be determined by the experience he gets in the Physics Club of his training institution."—TEMPLE.

Professor Temple is Head of the Department of Physics, Southwest Missouri State Teachers College, Springfield, Missouri. A veteran, he has discovered the secret of combining principles with practicality, and leads in the newest techniques of

A PROFESSOR OF PHYSICS IN A TEACHERS COLLEGE

ALLEN PORTER TEMPLE

WHAT are the activities of a teachers college professor of physics? Constantly changing conditions make the answer to the question a difficult once. A high degree of variability comes from the geographic location of the college, the relation of the Science Department to other departments, and the ever changing demands of the district.

In the set-up of the mid-western teachers college we find a mixture of all the demands made in various types of colleges, from the highly standardized technical school to the highly developed liberal arts college. The motivating factor is one of great complexity.

From the utilitarian angle we have the student with the radio complex. He has had experience in his home town as a general repair man and desires to take a course in physics that will start him on his way as a radio engineer. We have the "pre-medic" and the pre-engineer, who demand the most approved type of laboratory courses. We have the student who is taking the work as an introductory subject in the general field of science. Then there is a large group of misguided or illy advised students who seek to escape the tortures of science by the easiest exit.

With the wave of popularity in the general field of physical science, school administrators saw fit to make the subject a general requirement. The increasing demand for general science in the high school made it expedient to formulate a general science minor, two-thirds of which is physical science.

Under such conditions it would seem to have reached the peak in enrollment.

The requirements for prospective teachers of science are set by the State Department of Education. Fifteen hours of physics are required and one term in the teaching of science, in addition to the education required for the education degree.

One urgent task is the coördinating of physics courses with related courses so as to avoid unnecessary duplication, to have balanced courses, and to look for the student's immediate good in the selection of minors.

Another need is the bringing of some of the various phases of physical science before the whole student body. For those preparing to teach we invite outstanding professors from the leading schools of education to lecture and advise the students majoring in science. We bring trained lecturers with sound scientific backgrounds and polished techniques in demonstrating some of the newest developments. Others with an engineering and philosophical background acquaint the student group with the rôle science is playing in the advancing world front.

The problem of the Physics Club demands attention. Much of this work will fall to the physics instructor. Selected groups from the different divisions are formed for outside study. New developments in photography need direction and advice. The Science Club is a high school fixture. This work must be done by the science teacher and his success or failure may be determined in a large measure by the experience he gets in the Physics Club of his training institution.

Closely allied with this group is the Radio Club. In schools situated in cities where a commercial broadcasting station is maintained we have before us the question of education by radio. With advances in short wave transmission it seems as though the project is worth investigation. Any such developments will probably be the special obligation of state supported colleges.

For years physics teachers have recognized the value of visual aids: maps, charts, drawings and lantern slides. Recent improvements in the sixteen-millimeter sound film gives another urgent activity for the physics teacher. The great demand for introductory courses requires improved methods in meeting these large groups. Will the sound film take the place of the lecture table demonstration? An immense amount of experimentation must be done before the question can be answered. Can we prepare those expecting to teach in the proper use of the sound projector? Can we justify the great initial cost and the heavy operating expense involved in such a program?

So long as we keep the name "teachers college" and, as such, are state supported, we have a real obligation to the district in training teachers for high school physics. They must meet conditions where the changes have been as far-reaching as in any college. The best ways to prepare young men and women for these duties are to keep in close touch with their classroom progress, to direct their reading, to train them in the new techniques, and acquaint them with the new fronts of physical science. Throughout all this, they should be grounded in the scientific method.

"Every student should get a kick out of physics, or get kicked out of physics."—GAY.

Mr. Gay is Instructor of Physics, Morgan Park High School, Chicago, Illinois. That his department has grown proportionately much faster than his school must be due to his ripe experience and practical philosophy as

A TEACHER OF PHYSICS IN HIGH SCHOOL

A. ROYALL GAY

I AM asked, "Just what does your job involve? What do you do as a physics teacher? How do you go about it?" May I answer these questions in the belief that my duties and experiences are typical of this field of science teaching.

As with any good workman, my first job is to know what tools I have to work with. A complete inventory of the laboratory must be kept in mind at all times. Every piece of apparatus, reference material and textbook must have a place and be kept in that place ready for use. My store of tools must be built up. Every junk yard or manufacturing company is a potential source. A set of roller bearings, an electric armature from an automobile wrecking place, wall charts and pamphlets, movie films from General Electric and National Lamp Association, are but illustrations of sources. Much of our reference material and apparatus has been collected or built by the instructor and students without cost to the school. Of course books and precision apparatus has to be purchased.

I must next know the material upon which the work is to be done—the student. It is not enough to know his name and face, but as soon as possible I must learn his mental habits, his background and his interests. A comprehensive test is given. From this I discover how well he can think in terms of mathematical relationships, and how successfully he can use mathematics to solve problems; whether simple scientific data which he uses or comes in contact with frequently has made any impression upon him; whether the windows of his intellect have been opened to the constant breeze of truth that would enter; whether he can get definite facts from the printed page. The result of this test gives me some idea of how deep I must go in order to find the student's intellectual bedrock, and tells me something of the nature of this rock. For, after all, my job is to take the truths of physics, collected from all ages and parts of the universe and brought to our laboratory by means of textbooks, reference material, knowledge and experience of students and instructor, and with the aid of the machinery of the laboratory and the tools of class and laboratory technique, to build upon this foundation a given structure—a knowledge of, an, appreciation for, and an adjustment to our physical environment, which includes the whole universe.

The actual class or laboratory procedure varies widely from day to day, depending upon topic and progress of the class. Physics can easily be divided into units, problems or topics. My method is to treat each of my

twelve to fifteen divisions as a learning unit, and the unit is assigned as a whole. The first day or two is spent in informal class discussion, in which the instructor does most of the talking, though not lecturing. Student interest and progress is sought and maintained by frequent questions and by student participation in the discussion. In this way the problem of the unit is gotten before the class, new terms introduced, and the plan of attack outlined. The day to day procedure from here depends upon the progress of the class and the particular problem at hand. In this the originality and the ingenuity of the instructor are given full play. I use whatever means or method I feel will be most helpful in accomplishing our purpose. It may be a laboratory experiment or demonstration, elaborate or simple, supervised study, class discussion, slides, movies, oral or written review, or problem solving. When we have finished the unit, a comprehensive test is given. The student's grade is based largely on the results of this test. We are giving neither a laboratory nor a lecture course in physics. We do not lecture because it is Monday, or test because it is Friday, or put on a laboratory experiment because it is "lab" day. A definite objective is set up and then every means at our disposal is used to accomplish this objective. Laboratory experiments, demonstrations, class discussion, supervised study, written work and tests are all means to one end, and must stand on their own merits. Our object is to cultivate in the student an appreciation of, a love for, and an understanding of the laws governing the physical universe around him and his relation to it.

There is no course in the high school curriculum richer in material or more closely connected with the student's daily life and experience than physics. With this wealth of material, possibilities and human interest literally thrust upon one, teaching opportunities are unlimited. My feeling is that when I cease to try to improve my effectiveness with new plans, new methods or procedure, and new techniques that I should be retired.

Here are a few things the Morgan Park High School physics department has done and is doing. We designed and built much of our equipment, including a 1,300,000-volt Tesla coil, electric transformers, choke coils, condensers, resistance units, photographic enlarger and printers, etc. We have charge of audio-visual educational work in our school, using four stereopticons, one balopticon, four motion-picture machines, one a sound machine, and two radios. With our own movie camera we make news reels for the school. Most of the pictures for the school publications, as well as individual pictures of every one of 2,400 students for the school records, are made by the physics department. We further link our class work with the pupil's interest and home environment by such problems as, "How much will it cost to heat water for a bath with coal, with gas, with electricity?" Home apparatus is brought to school for test of operation and efficiency. As a result of this approach to our subject, boys and girls crowd our classes.

Our real problem is to convince students and parents that physics is

not just a beginning course in mechanics, suitable only for boys, but one which unfolds to all the marvels and beauties of nature as objectified in the material things around us. There is nothing more soul-enriching than an appreciation of the wonders of physical nature, such as that light of different wave lengths put together in a simple mathematical ratio makes a beautiful picture, or that sound waves make a symphony. The task of the high school teacher of physics is to introduce the student to this vast field of truth and to create in him an admiration for it and power to enjoy it.

Any individual contemplating teaching physics in high school will of course major in physics and education in college, including courses in theory and practice of teaching. He should also include courses in mathematics, psychology, history and public speaking. The progress of the human race can largely be written in terms of man's discovering and using the laws of nature as objectified in his physical environment. Valuable as academic training may be, that alone will not make a physics teacher. The successful high school teacher will know more than his own restricted field. The broader his knowledge the better. My own familiarity with Greek and Latin reveals that most of our new physics terms come from these languages.

A sustained interest in youth, a sense of humor, and a continued enthusiasm go with good teaching. We cannot interest others in things we are not interested in, or enable others to enjoy that which we have not enjoyed. My first lesson in physics was when I yelled at two minutes of age. These lessons have continued in rapid succession ever since. The last one will be my final breath. I learned the law of the lever watching my father pry up stumps on the farm before I was four years old. The use of the pulley, the inclined plane and the jackscrew soon followed. The real physics laboratory is our daily life.

Our high school laboratory is but a makeshift. Unless you have long enjoyed working in nature's great laboratory, you will find it difficult to interest others. It would be hard to imagine a real physics teacher who did not know how to use tools and enjoy using them and watching others use them. The more complex the tool or machine the more intense the interest. Beyond the tool and machine lie the simple yet profound laws of physics. From the little electron to the great galaxies of stars, from the fall of an apple to a great orchestration, everything seems to follow carefully planned laws—the laws of physics. Unless the discovery and observation of these laws give you a thrill then physics is not your field. The motto of my laboratory is: "Every student should get a kick out of physics or get kicked out of physics!"

"Our major concern is what goes on in the classroom."—HIGHSMITH.

Dr. Highsmith is Director, Division of Instructional Service, Department of Public Instruction, State of North Carolina. His own early teaching experiences were largely in science, and we may be sure that science receives expert administrative attention as he performs his duties as

A STATE DIRECTOR OF INSTRUCTION

J. HENRY HIGHSMITH

WHAT do I do as Director of the Division of Instructional Service for the State of North Carolina? In other words, how do I spend my time, what are my duties and obligations? First of all, the activities of the members of the Division—three men and three women—must be directed and coördinated. The Division is responsible for the program of instruction in both elementary and secondary schools. Three members of the staff, two women and one man, devote their time to the elementary schools; one man gives his whole time to high schools; one woman is in charge of library work in all schools; and one man has charge of physical and health education for both elementary and secondary schools.

The Director is responsible for carrying out the program of instruction in the 100 county and 69 city administrative units, in which 26,000 teachers are employed and nearly 900,000 pupils are enrolled.

Some of the major aspects of the instructional service which the Director is responsible for are the following:

(*a*) The accreditment of elementary and secondary schools under rules and regulations set up by the Division. These requirements are printed in a bulletin called "The Handbook for Elementary and Secondary Schools." Accreditment is emphasized as a means of securing satisfactory situations for teaching.

(*b*) Conferences. Between June 1 and October 1 of each year, administrative conferences are held for the superintendent, elementary and secondary school principals in each of the 169 city and county administrative units. Conferences also are held at other times on various topics or subjects when special emphasis is needed. During the session 1937-38, one hundred forty conferences were held for suprintendents, principals and teachers on the following subjects: Safety, Oct. 4-9; Art, Sept. 13-Oct. 2; High School English, Sept. 20-25 and Oct. 18-26; Music, Oct. 4-16; Physical and Health Education, Oct. 11-Nov. 19; High School Science, Oct. 18-Nov. 13; Social Studies, Nov. 15-Dec. 11.

(*c*) Statewide Seventh Grade Test. This test is given in city and county administrative units at the end of the seventh month. A standardized test is administered.

(*d*) Statewide High School Senior Examination. This is prepared by the Examinations Committee of the North Carolina College Conference.

(*e*) Preparation of bulletins and Course of Study materials—a continuous, never-ending job.

The Director of Instructional Service is a member of the following organizations in the State: Board of Certification of Teachers; Board of

Commercial Education (Private Schools); College Rating Board; Board of Editors of North Carolina High School Journal; North Carolina College Conference; Vice-President North Carolina Education Association; Chairman of Committee of School Health Service (State Board of Education and State Board of Health). The Director is connected with these out-of-state organizations: Coöperative Study of Secondary School Standards; Chairman, Library Committee of Southern Education Association; Secretary, Committee on Approval of Negro Schools of Southern Education Associaton; Chairman, North Carolina Committee of Commission on Secondary Schools of Southern Association.

The Director's main job, however, is to see to it that the real function of the Division is performed. His conception is that the function of the Division of Instructional Service of the State Department of Public Instruction is to bring about effective teaching in all the schools of the State. Our major concern is what goes on in the classroom. Whatever affects the educative process when a teacher instructs or directs children in any class or grade is a matter of concern to us. In other words, our chief business is to make actual classroom work effective.

There are numerous factors that affect directly or indirectly what a teacher does. There are certain physical factors, such as sanitation, heat, light, furniture, and other items of school equipment which modify the learning situation. These things, to the extent that we have jurisdiction over them, are our concern. More directly, however, we are concerned with the activities which should go on, a fairly satisfactory physical situation having been provided. In deciding what should be done in any administrative unit, city or county, there are certain influences which should be taken into account:

(*a*) What is the present situation? A survey, even though it may be somewhat casual and incomplete, should be made to determine what is actually going on and the conditions under which teaching is being undertaken in the administrative unit.

(*b*) To what extent is the Course of Study being used, and what evidence is there that teachers know how to use the Course of Study helpfully?

(*c*) What evidence is there that pupils in the grades are making satisfactory progress? In other words, how do these pupils measure up when judged by standards agreed upon for children who are approximately of their age and training? Does this particular school or unit of administration have a testing program as a measure of the effectiveness of teaching?

(*d*) How well are the schools organized? Are pupils properly classified? Is there a well-defined plan for moving children from class to class or grade to grade? In other words, is there a well-conceived plan of promotion and is the plan being used successfully? Is there any agreement on the part of the superintendent, principals and teachers of elementary and high schools with reference to standards for promotion?

(*e*) Is there a well-defined program for the training of teachers in service? Are teachers' meetings carefully

planned with a definite program of work? Is constructive study being done and are the problems of teachers being met? Most important of all, have the teachers made diagnoses of their problems, and is there a conscious effort to arrive at solutions? The activities of teachers' meetings should be of a generally helpful or professional character, but they should be definitely pointed to the handling of problems which are inherent in local or county or city situations.

(*f*) Is an effort being made to build a curriculum and to write or develop a Course of Study that will be increasingly responsive to the needs of boys and girls? Does the Course of Study provide for a rational plan or program of scientifically sound activities or units of instruction? The Course of Study should reflect the changes that are going on in the world, but at the same time conserve that which is basic and fundamental in what the race has experienced?

(*g*) Is proper emphasis being placed upon certain phases of school work that are sometimes neglected? For example, are health, physical education, music, art, given their due attention. Are the schools using the radio and visual aids in a helpful and modern manner?

In answering all of these questions and taking all of these problems into consideration it will be necessary to consider the set-up in any given case, whether it be an individual school, county or city unit. Proper regard must be had for organization and administration, since these matters so vitally affect classroom procedure. Transportation is important because it relates itself to instruction. All other phases of school organization affect what goes on in the classroom and merit, therefore, thoughtful consideration, but fundamentally our aim is to affect classroom instruction in the most helpful way possible, to the end that boys and girls may be benefited maximally.

With the multitude of claims upon our time and energies and in view of individual tastes and inclinations, we are constantly under the compulsion of evaluating the various aspects of our work and under the necessity, therefore, of deciding in favor of those activities which are relatively more valuable from the standpoint of the aim or function of the Division of Instructional Service. Try as we may, we cannot "be all things to all men."

There are certain relationships which the Division of Instructional Service sustains to other organizations and agencies which have to do with the education of boys and girls. These are:

The North Carolina Education Association. Membership in the Association, sponsoring its program in a general way, and making contributions to "North Carolina Education" from time to time.

The Parent-Teachers Association. Hearty coöperation with this organization, serving on appropriate committees, such as art, music, dramatics, et cetera.

The State Federation of Women's Clubs. Membership in a local club and affiliation with state organization, serving on committees fostering any particular phase of the public school program.

Business and Professional Women's Clubs. Participation in program as it relates itself to public education.

The North Carolina Art Society. Participation in program as it relates itself to public education.

The North Carolina Historical and Literary Society.

The National Education Association and its subsidiary organizations.

The American Association of School Administrators and its subsidiary organizations.

The Southern Association of Colleges and Secondary Schools. This organization has a vital relationship to our work.

The North Carolina College Conference.

The North Carolina Library Commission.

The State Board of Health.

The State Textbook Commissions -- Elementary and Secondary.

The State School Commission.

Other Divisions of the State Department of Public Instruction.

In considering the extent to which we should participate in the activities of these organizations just listed it is necessary to keep in mind the function of our Division and that of these social and civic agencies. We should coöperate unquestionably, but we should not assume authority or leadership when this can more appropriately be placed upon some person not officially related to the State Department of Public Instruction.

"If you can repair the wall switch . . . you have made a believer out of father and son as to the value of science and your ability to teach it."—BATES.

Mr. Bates is Head of the Science Department, Dickinson Junior High School, Chattanooga, Tennessee. He is demonstrating to a large community the true usefulness of

A TEACHER OF GENERAL SCIENCE IN HIGH SCHOOL

CONRAD W. BATES

THE day has passed when a general science teacher sits smugly behind a rack of test tubes, a balanced aquarium and an inclined plane to describe to the child the mere principles of science as discovered by earlier generations. The activities of the modern general science teacher are vitally related to the everyday life of the child. With the coming of this age of machines and efficiency the philosophy of science education has materially changed. With this change the duties of the science teacher have become more practical, more vital, and certainly more varied. He not only teaches applied science but practices it in the school and throughout the community.

The routine duties of the science teacher, aside from those of any other teacher in the school, include the use and care of scientific apparatus, collection of teaching materials, grading of laboratory manuals, maintenance of fire extinguishers, light switches and circuits, and the performance of other related odd jobs, such as devising a temporary dimmer switch for the stage lights, or installing a spot light. In addition, the science teacher has opportunity to do many things that require much thoughtful planning and, in many instances, no small amount of ingenuity and resourcefulness. Herein lies a challenge to put into action new ideas and plans that do not fit into the formal curriculum. These enable the teacher to grow, and quite often bring him to the solution of some of his most serious teaching problems.

The purpose of this article is to describe some of these activities as experienced by the writer, and to show how they have helped him in the classroom. These may be analagous to problems of others, and may make clearer the qualities and training needed to be a successful general science teacher.

Sometimes the development of the proper attitude and interest must begin with the parents. They must be shown that the subject matter of a science course is of practical value to their child; they must be enabled to explain this value to the child. Visits to the homes of students offer these opportunities, especially in rural communities where service men are not to be found. If, for example, you can correct some minor ailment of the radio by tightening a few screws or getting the pilot light to burn, or if you can fix the short circuit in the floor lamp or repair the wall switch, and at the same time explain to the owner how you were able to find the trouble, you have made a believer out of father and son as to the value of science and your ability to teach it.

A certain cold Saturday morning I spent with a boy and his father crawling about in the attic of their home to help them work out the problem of wiring the house for electric lights, was well worth the effort expended. The boy, a disinterested and failing pupil, became an ardent science student and passed his work with commendable grades.

A conscientious science teacher is going to find opportunity to spend some time in close association with his students outside the classroom, helping them to solve their problems with sympathetic understanding as he gains their confidence. One boy, I recall in particular, was considered one of the worst disciplinary problems of the school. He became one of the better behaved students after a few field trips with me on which we discussed character and some of the finer things of life along with our science. Further, he became interested in our school museum and prepared a very fine collection of woods to be placed in it. A little guidance and judicious praise had its effect.

One who would be a successful science teacher must listen with a sympathetic ear to the very real problems of the children, and help them to solve these problems with the vital subject matter of science. Only yesterday I sat as counsellor for a boy scout who wanted to earn a merit badge in photography. After P. T. A. meeting some weeks earlier, his mother had asked my help in selecting photographic equipment for his Christmas gift. A girl interested in a religious program wanted to know what chemicals to use and the procedure to follow for getting the effect of water changed to blood or wine. Another girl and her brother were made happy when a little copperas from the school laboratory restored their pet dog to his usual playful disposition. A ninth grade boy could not get his newly made picture enlarger to operate properly, but an evening spent in his home experimenting permitted the necessary adjustments to be made and enabled me to meet his paretns and establish a most congenial relationship.

A program of chemical magic rendered at a football banquet with the aid of student helpers, did more than

entertain the guests of the evening. It awakened a new interest in the work of the science department and led to better coöperation of the athletes in the laboratory. Young people are always interested in the new and the spectacular. Advantage can be taken of this to create interest and at the same time teach important principles. Place a chemical garden in the window, set up an osmosis apparatus, arrange flasks of brightly-colored solutions on the desk where they may be seen from the doorway, place pictures and clippings of scientific interest on the bulletin board—these are but a few tried and true schemes. Perhaps the children cannot understand all the principles involved in such demonstrations, but they are inspired to study toward that goal.

Many science lessons are taught effectively by means of the chapel program, where the child primarily interested in drama may get much practical knowledge and at the same time realize the cultural value of science. A pageant of the heavenly bodies, or of the fight against disease, prepared and presented by the science students, gives them a motive for acquiring more scientific information than they might realize from a dozen formal recitations.

The science teacher, in practically every location, is expected to sponsor some type of science club. This gives opportunity for departure from the fixed curriculum. The child can pursue that branch of science in which he is most interested, developing it as a true hobby. The sponsor finds opportunity for much informal instruction, and through the proper guidance can keep the activities of the club sufficiently organized to prevent a mere chaotic accumulation of unrelated facts through its programs.

A camera club, for example, does more than make prints from any negative at hand. Our club started with the study of the camera, its structure and the principles involved in its operation. The chemistry of printing, and the processes of printing and enlarging pictures, have been presented in elementary form. Composition and subject matter are being studied in the development of picture-taking technique. The club plans to close its season's activities with an exhibition of its work.

In recent years many science teachers have experienced difficulty in getting sufficient materials and equipment for laboratory work. Much of the teacher's time outside of classroom work must be spent tramping the woods and water-courses hunting specimens, or in the shop building apparatus. A large proportion of this work may be done by students as individual projects under the active supervision of the teacher. If one is fortunate enough to be in a school which has a shop, work will be in collaboration with the shop teacher. Many suggestions for constructing apparatus are found in science magazines.

Equipment to take the place of that which would have cost over one hundred dollars was built by our own science students as individual projects during the year. A cheese-box and two small mirrors from the dime store were used to construct a photometer. A wooden wheel cut out with a neigbor's band-saw, a spool, the rear hub and axle of a bicycle, and a rubber band cut from an old inner tube pro-

vided the essential parts of a rotator for revolving color and siren disks. Some binding-posts from a castaway radio, and a piece of scrap lumber were utilized to build a simple wheatstone bridge. A piece of metal conduit from a discarded heating system was used in constructing a workable reflecting projector. A boy in the camera club is working at present on an automatic printing box as part of the equipment for our darkroom.

One morning two boys brought an owl to school which they had killed the night before while hunting. That afternoon the boys and I received our first lesson in taxidermy when we skinned the owl. A few weeks later we mounted our specimen and placed it in the school museum. Amateurish in appearance the owl most certainly is, but it has created the desired interest and is serving its purpose in nature study.

Such projects not only supply much needed apparatus but also help the students to understand more thoroughly the scientific principles involved. Discretion in assignment of projects takes care of individual differences among the members of the class.

The foregoing discussion has presented typical activities of the general science teacher. It is evident that a person preparing to become a science teacher must be far more than an idle dreamer. He must be an energetic person who realizes that his best efforts must be put forth from the time he starts his training until he ceases to teach.

In the light of past experience the writer suggests the following points as worth the serious consideration of one who is preparing to become a general science teacher in high school:

(*a*) You must have a general education to teach general science well. Amass and remember as many facts as you can pertaining to science and related subjects. Your ability to readily answer related questions develops confidence and offers opportunity for driving home scientific principles.

(*b*) Study some of every branch of science that you can possibly get into your curriculum, but concentrate on one and become thorough in it.

(*c*) Special study of such popular subjects as radio, photography, and taxidermy is invaluable for sponsoring clubs.

(*d*) Aptitude with tools and machinery is an asset in assembling and constructing apparatus. If the need is felt for it, a short course in general shop work and applied electricity is advisable.

(*e*) Curiosity and the habit of close observation are essential qualities that must be developed if you do not already have them. Without these you will miss many opportunities of getting material for laboratory and class.

(*f*) Become an ardent student of nature. Learn how to find the things you are looking for on a field trip. Become familiar with the plants and animals of the community in which you teach. The child will expect you to name many of them.

(*g*) Above all, be a sympathetic human being of impeccable character, who can develop the moral responsibility in the child that must go hand in hand with scientific knowledge. Be capable of winning a student's confidence by listening to his problems, and

giving well considered advice toward solving them.

In short, be a tireless, conscientious worker of no mean ability, who glories in the dissemination of knowledge and its application in helping man to find his place in the great scheme of creation. Then you may be an efficient teacher of general science in the high school.

"A teacher finds that he must have an understanding far in advance of information given in the texts."—PLATT.

Mr. Platt is Instructor in Biology, Jefferson Senior High School, Roanoke, Virginia. Well-trained, young, and very enthusiastic, he is learning rapidly in service what it means to be

A TEACHER OF BIOLOGY IN HIGH SCHOOL

ROBERT B. PLATT III

SITTING here behind his desk at the close of the Fall Term, the writer's thoughts go back to that first year of teaching. Armed with a Master's degree, a well-developed technical and theoretical knowledge of biology, preconceived and really very wonderful ideas of how to teach it, and a gap of six years since the last visit to a high school classroom, he confidently entered a small but top-ranking high school in the mountains of eastern Kentucky. His classroom subjects were biology, chemistry, general science, and mathematics. From that school, less confident, but far wiser, he came here to spend the past two and one-half years; here where ten to fourteen classes of biology are taught at once, and five classes a day are his assignment.

This article concerns the adjustments necessary to correct the handicaps of that first fall. The classroom situation has been faced from many angles, and the comments that follow are based upon experience, paralled, no doubt by that of many others in this profession.

Activities. What are the activities, the daily tasks, of a biology teacher? Space does not permit a complete listing, but the outstanding ones may be given in three groups: activities before school, during classes, and after school. On arriving this morning at the combined classroom and laboratory (the usual high school set-up) the three aquaria were briefly observed. The guppies being in good health, the terraria were the next objects of observation. The aphis were still multiplying and the plant seemed doomed. Two notations on the note ledger were quickly taken care of and the experimental material for osmosis was checked for its readiness. Three pictures were added to the pile under the opaque projector and all was in readiness for the day's work. Once classes start there is no time for things left undone.

Classes follow, one after another. If the teacher presents only biology on one level, the classes will be very much alike. As most of the high school classes are set up on the fifty-five minute period basis for each day of the week, laboratory work comes whenever the opportunity arises. This is very fre-

quent, for biology is one subject that can be taught best through student experimentation and observation.

People ask: "Is it not tiresome teaching the same things over and over again the same day?" Quite the contrary is true. In the classroom the rôle of the teacher is primarily that of motivation and guidance. Each group of students is different, individually and collectively. They are interested in different phases of the material, and methods of approach must vary. Herein is one of the reasons why teaching biology is most fascinating. Each day, indeed each hour, new opportunities are given, not only to the teacher but to the student. This comes through the use of living and preserved material, use of apparatus and equipment, field trips, evaluations, current literature, oral and demonstrated exchange of information and experiences, and the integration of material with other classes. Biology is so broad, there are almost no limits as to what or how things may be done. Yet biology is simple, for all is based around a few major understandings of life. So the classes pass quickly, almost too quickly. Then there is much to be planned for tomorrow. The teacher's attention is turned to grading papers, keeping class records, obtaining miscellaneous laboratory materials, conferring with students, looking up library references, cleaning up, straightening up, ordering supplies, integrating with other classes, and sundry other duties that will end the day.

Problems and Opportunities. In thinking through the problems and opportunities of teaching, the writer finds that there is not a clean-cut differentiation between the two. All problems present opportunities and opportunities present problems. The writer is certainly not dogmatic in the separation here given.

Some of the things that seem primarily problems are lack of financial assistance, time, equipment, space, and — yes, often — inspiration. Yet these handicaps, turned into challenges, make for better work through the ingenuity and resourcefulness of the teacher. Extracurricular activities are on the surface a serious problem, for they often take most of one's time outside of classes and often compromises must be made. One must accept the fact that biology is just one of the important things in the students' lives. Even this problem can often be turned to advantage, for biology is the study of life, and through both its factual and social implications it lends itself readily to integration.

Another group of problems deals primarily with the actual presentation of materials in a functional form. This is through techniques of teaching, experiments and demonstrations, discipline, motivation, and the teaching of pupils to think and to use, rather than to memorize and to forget. Here indeed are opportunities for research as to the educational approach.

A third group, more nearly classed as opportunities, would include the exploring of new fields through the activities of students, advantages of supervised training, reading and study, extension courses, personal contacts with scientists and with science associations, so-called summer vacations with their types of broadening experiences, coöperation with civic, state,

and national activities, and individual research.

The last topic mentioned, research, is often one of the greatest disappointments to the new teacher, particularly to one who has been so engaged in a pure science. He will be unable to continue on the same scale to which he was accustomed in college, if at all. If it is not possible to investigate along the same lines, many others are opened through the approaches of both education and of pure science. Since a teacher often makes his own opportunities when they are not offered to him, there is no need to follow no path of research because a certain road seems closed.

Training. The discussion here deals only with preparation for teaching biology. Today most school principals think in terms of Master's degrees and usually two years of experience. It is desirable to have teaching experience between the two degrees. Assuming general degree requirements to be adequate, three special aspects of a college course should be planned specifically for the biology teacher's basic needs:

(*a*) In foreign languages, Latin is of much value, and French and German of service. The latter two are needed primarily for graduate and research work.

(*b*) Sound practical psychology courses are valuable because of their information concerning the nervous system of the body and their application to the individual treatment of students, to discipline, to motivation. Education courses giving functional teaching techniques, organization of material, and modes of evaluation are helpful when sufficiently elastic and adaptable that they may be used as a background in teaching biology.

(*c*) In undergraduate science courses, breadth of experience is far more desirable than intensive specialization. In graduate study a major in biology with a minor in one of the social applications of biology, as psychology, sociology, education, is a good combination. The practical side throughout should be emphasized over the theoretical aspect. Reasons for all this may be found by examining the table of contents of one of the newest biology texts. We find such a text dealing primarily with elementary material on zoology, botany, taxonomy, ecology, bacteriology, genetics, civic welfare, and economics. It deals to a minor extent with chemistry, physics, geology, mathematics, psychology, evolution and sociology. Proportions vary, of course, with different texts. A teacher finds that he must have an understanding in these fields far in advance of information given in the texts.

In summation, it is evident that college courses in many subjects, with continual and intensive study of the newspapers, magazines, scientific journals, books and other sources of information, will give one major training in biology and an adequate background for teaching it in high school.

"The aspiring teacher of chemistry should be willing to work harder than the ordinary pedagogue."—WEAVER.

Mr. Weaver is Chairman of the Science Department, Bulkeley High School, Hartford, Connecticut. Throughout all New England he is known as a broad-minded specialist, somewhat conservative, but alert to his opportunities as

A TEACHER OF CHEMISTRY IN HIGH SCHOOL

ELBERT C. WEAVER

THE art of teaching something to somebody can be skillfully developed in the teaching of chemistry to pupils. School administrators sometimes purposely over-emphasize the pupil side of teaching, while professional groups of teachers may stress the subject-matter side. A chemistry teacher should indeed know pupils, but a chemistry teacher must know chemistry as well. Either knowledge unsupplemented forecasts disaster. The unsympathetic, impersonal peddler of facts has no more place in the modern classroom than has the unqualified master of method, spreading falsehood by the most approved means—a dangerous person indeed! A course between the Scylla of method and the Charybdis of facts is desirable.

The modern secondary school chemistry teacher is a combination chemist and counselor, scientist and sympathizer. After he has discharged the duties connected with the devotions and records of a flock of home-room pupils who inhabit the laboratory, his duties as science instructor begin. The routine consists of meeting recitation sections or laboratory classes, staying on the job during recess and after school as long as pupils are present. This obligation is peculiar to the subject, chemistry, and its neglect may bring much regret. After school there are pupil conferences, committee meetings, club activities, correction of papers, preparation for laboratory work or for demonstrations, and study.

The classroom receives its share of modern distractions. Traffic, airplanes, and school noises all raise the decibel level. The vagrant, attention, is often far dissociated from the physical body of the pupils. The teacher must supervise the physical conditions of the classroom, overcome distractions, create a friendly atmosphere, and then challenge the attention by intriguing questions or arresting demonstrations. The daily program must be varied to include stories, problems, pupil participation, classroom moving pictures, demonstrations, and blackboard work, all sprinkled with a garnish of wholesome fun.

New ideas may be introduced in a class which is sufficiently well advanced and understanding to coöperate. Sometimes a pupil will be glad to work out a modification of an experiment or a demonstration, but very often the chemistry club members are a well-spring of enthusiasm for suggestions and the development of new plans.

The most important problem facing the teacher of today, chemistry teachers included, is twofold: (*a*) challenging pupils of superior talent, and (*b*) stimulating pupils of limited ability. Courses are likely to be paced for the average pupils, neglecting in part the preparation for leadership on the one

hand and the wasting of time gracefully on the other.[1]

Penetrating the schoolroom of today is a huge indifference towards hard work. This attitude is fostered by many relief agencies. Subsidized indolence has become so common that many pupils have never seen their parents or any one of their family do an honest day's work. Under these conditions it is a vexing problem—but doubly essential—to cultivate a work attitude and to show pupils that real happiness can result from hard labor. More than ever it is necessary to teach cleanliness, order, and disciplined conduct by insisting on scrupulous care of the laboratory and its apparatus.

The organic nature of the subject-matter of chemistry and its rapid developments, make professional growth a real necessity if chemistry is to be taught successfully. The chemistry of college days needs constant reinterpretation in the light of new researches and new applications. An excellent way to keep posted is through reading the *Journal of Chemical Education* and participation in regional chemistry teachers' meetings. In this area the New England Association of Chemistry Teachers holds eight all-day meetings each year. Ideas are exchanged, mutual problems discussed, and new developments thrashed out. Associations in other regions are rendering a similar service. They merit the support of both teachers and administrators.

A minor but insistent problem is the dispelling from the minds of pupils certain false ideas. Science is faithfully misrepresented in much popular advertising which bears the word *science,* or *scientific.* Science may even be described as synonomous with magic. A curious mixture of health study, physical education, and homemaking may have been called science in the lower grades. Moreover, the pupils may have studied that gross misnomer—social science. It remains for the senior high school teacher to interpret real science and to put the true significance into the term *original research.* This name is used by some teachers when they simply mean a reading of references.

One who plans to teach chemistry should get a good background in several sciences with specialization in chemistry. He should study mathematics, languages, and other "hard" courses in the college curriculum. Most states require some courses in methods also. Contacting the state licensing or certification board for the detailed requirements is advisable. The candidate should also possess a measure of manual dexterity Ability to use office machines and projectors of all sorts is a definite asset. Knowledge of the language of the artisan—mechanical drawing—is most helpful. A little dramatic ability and a balancing sense of humor are allies of any teacher in the fight for attention.

In all, the aspiring teacher of chemistry should be willing to work harder than the ordinary pedagogue, for in addition to pupils, papers, club activities, committee work and professional activity, there are many details connected with supplies and apparatus, all of which gets dirty with use. There are times when he must doff his white collar and become a true laborer. Any person who gets no joy from honest drudgery in a laboratory should seek some life work other than that of a high school chemistry teacher.

1 The New England Association of Chemistry Teachers is studying the problem of chemistry for the non-college pupil. Those interested are advised to contact Mr. Carlton D. Blanchard, Norwich Free Academy, Norwich, Conn.

"The supervisor must be able to recognize scholarship and good craftsmanship among his teachers."—WILDMAN.

Dr. Wildman is Director of Science Education, School District of Philadelphia. His leadership in organizing this Division and administering it for many years, indicates his fitness to advise us on the work of

A SCIENCE SUPERVISOR IN A METROPOLITAN AREA

EDWARD E. WILDMAN

THE work of a supervisor of science education in any large city during the past two decades has been most interesting. He has had no monotony, and little leisure.

First, through the 1920's, the school plant was expanding steadily. War industry had drawn thousands of families into our city and our schools were overcrowded. Our own Board of Education mapped a building program which would provide adequate accommodations for Philadelphia. This meant doubling our capacity in junior and senior high schools and adding many modern elementary schools. During that decade the building program was steadily followed.

Then came the depression of the early 1930's. The drop in local industrial activity occurred just about the time that major rapid transit facilities to the city limits and beyond were completed. As natural results of both of these events, and of reduced immigration and falling birthrate, our school population—especially in grades 1 to 6—fell rapidly. Throughout the present decade this decline has continued. Our major source of revenue for the support of the schools is a tax on local real estate. Assessed valuations have fallen greatly and yet, notwithstanding this, last year the age for compulsory school attendance was increased by state law.

There is the general school picture in bold relief.

And now for the problems of our science instructional program that have arisen out of these conditions.

Our science instruction receives special emphasis at Grade 8 and above. With the addition of a dozen junior high schools, each housing 1,800 to 2,000 pupils, and five or six new senior high schools, each housing an average of 4,000 pupils, most of whom will study science for at least two years and many for four years, urgent problems arose for solution. Among these were the following:

How to secure an adequate corps of well-trained science teachers.

Agreement of teachers, principals, and staff officers as to science curriculums.

Minimum standard lists of equipment, apparatus, and supplies.

Methods of requisitioning these so that they are available when needed, and purchased at least cost.

Minimum standard lists of text and reference books.

Methods of requisitioning these and of their purchase at least cost.

Use of laboratory equipment.

Use of transportation equipment for pupil visits to local science centers.

Use of visual aid equipment.

Modification of instruction to meet the needs of pupils who are mentally less able but who are held in school both by older and by recently enacted legislation.

Inclusion in all science courses of more emphasis on "consumer science."

Inclusion in all science courses of more emphasis upon the relations of science to industry and vocations.

Special science courses and excursions for pupils of high intelligence.

Guidance of club work in the various fields of science.

Modifications of laboratory study made necessary by ever-increasing size of classes.

The search in our older schools for apparatus, often long out of repair and unused, that could be put back into service at small expense.

City-wide science testing programs.

In 1925, after the extension of our building program was well under way, our superintendent of schools recommended to the Board of Education the organization of a division of science education and the appointment of a director of it as a member of his staff. This sentence was used by the supertinendent in his report of the organization of the new division: "Science being a subject pursued by thousands of our students, 39,000 to be definite, and handled by various methods in different schools in accordance with varying standards, seemed to need coördinating through a central division." Through a spirit of the most genuine coöperation this coördination has gone on through the intervening years.

Roughly, the methods used in the study of our problems at the beginning of the division's service were these:

Our science teachers, numbering nearly 400, were invited to meet in separate subject groups, and one or more of these major problems (listed above) were laid before them. Volunteers were assigned for intensive study of sub-divisions of each problem, to report their findings to the whole group later. Representatives of the purchasing department helped with the study of requisitions; members of the division of research and results helped with the building of tests. The directors of our great scientific institutions met the assembled science teachers and described briefly how they could take care of our pupils. These institutions are now visited by thousands each term. Our total enrollment in science has increased to nearly 52,000, yet the per capita cost of instruction has been lessened. A nation-wide Coöperative Testing Program administered during last school year shows that our success in science instruction is well up to the author's standards.

Courses for teachers in service continue. Teacher initiative is encouraged and results of newer methods are reported to colleagues both in group conferences and through visits of the supervisor.

Opportunities for the revision of the supply lists and of textbook lists are given to teachers annually, and special requests are considered favorably when based on adequate reasons.

Local tradition of leadership in two great fields of applied science—industry and medicine—held by our community since the city was founded, is recognized as a stimulating force in our work.

As for the training which would qualify one for successful supervision of science education, it is clear that this must go beyond college and teacher training school courses. The supervisor must be able to recognize scholarship in science among his teach-

ers, and he must be able to recognize just as readily good craftmanship in teaching among them.

These attitudes of mind, together with discretion in counseling with principals concerning the work of weaker teachers and with these teachers themselves, must be considered as basic. Beyond this, the science supervisor should show a leadership which will be stimulating professionally and culturally among his colleagues, and a positive force for the advancement of the best interests of his community. Wherever he lives and works he should be found urging his neighbors, tactfully, to enjoy as well as to use the out-of-doors and recent discoveries of science. The science supervisor can be no mere watcher of the clock!

"One who is trying to help others do better teaching cannot himself be a 'back number.'"—RAWLINS.

Dr. Rawlins is Head of the Department of Science, Divisions 1-9, Public Schools of the District of Columbia. His experience at all grade levels qualify him to discuss the activities of

A SCIENCE SUPERVISOR IN A LARGE SCHOOL DISTRICT

GEORGE M. RAWLINS, JR.

THE work of a science supervisor who may visit ninety elementary, eighteen junior and senior high, and three vocational schools is far from monotonous. The duties of a department head in this school system are quite varied. The work may be classified somewhat as follows: (*a*) contacts with teachers; (*b*) office work; (*c*) preparing and scoring examinations; (*d*) assisting in the compilation of apparatus, equipment, and supply lists; (*e*) attending meetings; and (*f*) professional reading.

(*a*) Probably the most important activity in the above list is the contacting of teachers through classroom visitation. The purpose of such visits is to improve instruction by studying and evaluating the work of the teacher and the learning situation. The association should be a coöperative and democratic process, with the teacher and the supervisor working toward common goals. The supervisor naturally makes suggestions to many of the teachers after a careful analysis of the learning situation, but the teacher must be in a receptive frame of mind before such suggestions are of particular value. In order to secure the fullest coöperation one must show teachers that he is not an inspector, that he is earnestly trying to be of real assistance in improving their programs of instruction, and that possibly he does have constructive suggestions to offer. In connection with the work frequent conferences must also be held with the building principals, and to make suggestions concrete supervisory forms are filled out and left in the building, so both teacher and principal may study them at their leisure. At times such forms may be left with the principal after each visit, but more frequently they should be filed after several visits and several conferences with the teacher.

Other important contacts of the su-

pervisor are the group meetings with teachers on the various levels of instruction. While it is not necessary for the supervisor to be the principal speaker on all such occasions, it frequently happens that he takes a leading part in the meeting. These meetings offer a fine opportunity to build up a spirit of coöperation within a department, to correlate instruction on different levels, to familiarize teachers with the latest studies and books in their fields, to assist with course of study revision, to let teachers report on their studies, projects, and techniques, and numerous other such activities. These meetings should not be called unless there is a carefully prepared program or a problem of importance for discussion. It seems that general discussions with groups of from fifteen to forty teachers are quite effective when carefully focused upon a topic of general interest. Where a supervisor holds such meetings with regularity, and for different subjects and on different levels of instruction, it means a meeting practically one afternoon each week in a school system of Washington's size.

(b) Routine office work requires much of a supervisor's time. Many items could be discussed, but only a few of the more important will be mentioned. After visiting a school a careful report must be placed in one's own files of the work observed and the essential points of all conferences which were held. The time required to make this report varies with the number of teachers visited during the day, but one will ordinarily observe from four to eight teachers, have conferences with them, and also confer with the building principal. It should not be assumed that the supervisor does this every day in the week, but there are many such days during each month. In addition to this report for personal files, copies of the supervisory form are also filed, as well as sent to the building principals.

Mail must be read every day and answered. At times the answering of a letter may require considerable time, as conferences may be necessary or information may have to be secured in other ways before it can be answered correctly.

Other duties, which are somewhat seasonal, involve interviews with the representatives of publishing and scientific supply companies, since the supervisor recommends to the textbook committees the books for listing at the various levels of instruction in his department, and suggests the laboratory and classroom equipment that is needed. Many applicants for teaching positions also call, probably merely to "take the measure" of the person who is responsible for preparing and grading the examinations. Conferences with such applicants can have no influence on the final grade of a candidate, as only numbers appear on the papers.

(c) As has just been indicated, teachers entering the system or transferring from a lower to higher level of instruction are required to pass comprehensive written examinations in content and methods in the fields which they are planning to teach. These examinations vary in length from one to three hours, depending on whether the subject is offered as a major or a minor. Each candidate is given three examinations: two majors or a major and a miner, and a methods

paper, at the junior and senior high school levels. The head of the science department has examinations each year in elementary science, general science for junior high schools, and biology, chemistry, and physics for senior high schools. When it is remembered that the candidates for positions in the senior high school have master's degrees in either biology, chemistry, physics, or education, it is evident that adequate papers cannot be prepared for them hastily. It is at the examination periods that a supervisor is busiest, for he attempts to keep his program of supervision from lapsing entirely even while he is scoring examinations.

(d) Another interesting though routine activity is the revision of apparatus and supply lists from which teachers select their materials for the year's work. There are also lists of apparatus, equipment, and supplies prepared periodically for new schools which are being opened. As the department head is supposed to be an expert in this field he collaborates with the business office in preparing these lists.

A science supervisor must also preview motion picture film prior to their purchase, assume responsibility for distributing alcohol used in all schools, check and assort microscope slides for the system, and perform many other duties of a similar nature.

(e) Schools are in session from nine o'clock in the morning until three in the afternoon, and comparatively few meetings of teachers are scheduled during these hours. After three o'clock, usually beginning at 3:45, there are quite a number of meetings which a supervisor, being a staff officer, must attend. An incomplete list of regular meetings would include those called by the superintendent of schools or by the various assistant superintendents; meetings of the heads of departments; study group meetings; committee meetings; meetings of science clubs. Three days a week on the average the supervisor is busy from about eight-thirty in the morning until after five o'clock in the afternoon. There are also many very worth while professional meetings to be attended in the evening, either within the school system or as the guest of other organizations.

(f) Even though professional reading is being discussed last, it is not to be considered as an unimportant feature of the supervisor's work. One who is trying to help others do better teaching cannot himself be a "back number." He must be familiar with the articles that progressive teachers are reading, as they are certain to bring them up for discussion at conferences. He must read the newer books, selected periodicals, new textbooks, and selected courses of study from progressive school systems in different parts of the country. A good reading program is not only time-consuming, but also somewhat expensive. Everyone is familiar with the costs of books and periodicals, but some may not realize that courses of study are also expensive. Many school systems charge approximately fifty cents for a course of study, and experience proves that this may contain only one semester's work. It is entirely possible to pay three dollars for a complete course of study in general science for grades seven, eight and nine. This is said in no spirit of

criticism, as school systems cannot afford to pay postage and furnish free of charge mimeographed material which may contain from fifty to one hundred pages.

The preceding pages indicate some of the activities in which a supervisor engages during the course of his regular work. It might be concluded from this that he does little which is not routine. It is true that much of his work becomes systematized, and to this extent routine, but this can be defended as an administrative economy. There is ample opportunity for a science supervisor to use initiative in introducing new courses which seek to provide for both slow and superior groups, in developing and revising existing courses of study, in improving techniques for evaluating the work of teachers and for discovering the weaknesses of instruction. There is no good reason for a supervisor to stagnate, or get into the proverbial "rut," if he attempts to meet even the most obvious needs which now exist in the field of science education.

In conclusion, a word may be in order to those who are preparing themselves for science teaching and think of advancement into supervisory channels. When one considers the scope of a science supervisor's field it is quite wide. In the junior and senior high schools he tries to assist teachers in the subject-matter fields of astronomy, biology, chemistry, geology, health, meteorology, and physics. A lifetime can be spent in any one of these areas and then leave much to be learned. In each of such fields the supervisor encounters teachers who know more about a particular branch of a subject than does he. A prospective supervisor should take a reasonable amount of course work in each of the fields mentioned and should teach as many of them as possible.

Emphasis must not be placed upon content, though, to the exclusion of methods courses, for it is impossible to separate the two from the supervisor's point of view. Consequently, a supervisor should have adequate training in such subjects as psychology, secondary education, tests and measurements, school administration, and methods of supervision, if he is to render efficient service to the teachers in a large school system.

In addition to these fields in which one should have thorough training, there is a need for much information about apparatus and equipment, preferably gained by much laboratory teaching. Nor can this discussion omit mentioning the fact that a good typist will have much to be thankful for in connection with his supervisory work. This latter skill is almost an essential, as there are so many letters, reports and bulletins to write in connection with the work, even though some secretarial help may be available.

Of course, one cannot know all that he should when he begins to supervise, nor will he know all he should like to even if he continues in the work until old age causes retirement. An excellent plan is to attempt to grow year by year. Probably some of the better ways to assist this growth are these: (*a*) maintain an earnest desire to assist teachers; (*b*) read extensively; (*c*) join and attend the meetings of professional organizations; (*d*) attend summer school frequently, and (*e*) contribute articles to professional journals when possible.

EDUCATION'S RESPONSIBILITY TOWARD DEMOCRACY

C. A. Harper

THE twentieth century may be viewed by some future philosopher of history as the age of the testing and clarifying of democracy. The sharp set-back of democratic life in the first third of this century may be viewed as stating the problem, the second third may be regarded as the period of definition of democracy, and the last third the age of its scientific application. The concept and application of democracy in the nineteenth century in Europe were so tied up with hazy idealism, the industrial revolution, the middle class ambition for political power, and nationalism, that the true logic of the democratic theory was obscured, forgotten or lost.

There the word "democracy" became so charged with emotion and so implicated in the development of a technique of revolution that it tended to become the shibboleth of the agitator and a mystical symbol with which to exercise any sort of oppression or injustice. The eighteenth century philosophers, with their appeal to reason and natural law had succeeded in coining a few hollow, dogmatic, and high-sounding phrases which, after the days of 1793, came to have less and less meaning. So Europe blundered along and although profound changes were effected in economic, political, and social life, there was in reality very little accomplished in the way of definition or conscious application of democracy.

Indeed, so little had been actually accomplished by way of establishing the true meaning of the concept and its implications, that the recent disasterous break up of so many of its concomitants left its shattered remains unable to stand thus shorn of certain institutions and practices which had been mistaken for the true democracy. For example, parliamentary government and a press not responsible to the government were not in themselves necessarily democratic. Too often parliamentary government represented merely the control of the state by powerful interest groups or by a monied class, and the vaunted freedom of the press meant its powerlessness to be rescued from the complete control by these same groups. When these groups in control of the state failed to rescue certain nations from the social and economic results of the World War, the public turned from them and looked for stronger leadership. In doing so there came the notion that democracy had failed and fascism and communism were thought of as competing and probably more successful systems.

As dictatorships increased in number and various schemes were tried to right the troubled course of the national life, in many areas idealogies come as a rationalization of the process. The phrases "autarchy," "the Corporate State," "five-year plans," yes, even communism and fascism were but satisfying bits of vocabulary-mongering, coined so that propaganda

for existing set-ups could be more easily managed. The idea being to obscure the fact that democracy as a philosophy of life as well as a form of government was not merely a background for certain types of nineteenth century institutions and practices but was the point of view of mankind whenever and wherever the average intelligence and knowledge developed in a people to the point of an appreciation of the dignity and worthwhileness of human individual existence. As propaganda for various systems became more organized and obtrusive many people began to speak of the necessity of propaganda for democracy. This cry coming even from educators, is a fine example of how successful the propaganda of dictatorships has been in maneuvering believers of democracy into a false position. We educate for democracy, but we propagandize for various "isms." That is, we feel that democracy is the natural and logical practice of a people who are educated in the truth as mankind has so far worked out the truth. We feel it is the way of the informed and openminded. We educate people so that they may be able to take care of themselves individually and collectively. Democracy represents the only way of doing this. Propaganda and indoctrination mean an emphasis on a particular pattern of beliefs to the *exclusion of all other ideas.* Democracy means freedom of choice based on freedom of association, communication and discussion. It resists dictation and force, and cherishes the individual's right to full development up to the limit of his capabilities. This is no delusion, as frequently some minister of propaganda tells his regimented dupes, but is the logical corollary to mankind being given a brain and a sense of self worth. No amount of emphasis on the inefficiency of some democratic governments in times of intense international strife, and no amount of laudation of a leader who has apparently unified the resources of the state in the colossal game of diplomatic bluff, can minimize the fact that democracy is the only philosophy of life for beings that are truly human. The issue is not one of rival ideologies testing their strength on fields of war. Democracy, fascism, and communism are not comparable terms. The issue is that the world has lagged in some places in the forward march of intelligence. Mankind has yet a lot to learn. Democracy has not, and from its very nature cannot, fail; man, however, may sadly fail in its applications and appreciation. Fascism and communism represent not competing systems but blind-alleys in the progress of the democratic ideal.

In our own country during the frontier stage, democracy was a fact, not a theory. It was merely a condition which was but a part of the pattern of existence amid surroundings in which isolation was the most important single factor. This condition was bound to pass as population grew more dense and as superior luck, energy, and intelligence would upset the economic equilibrium. If democracy were to be preserved and used as a frame of reference a great many attitudes or mindsets would have to be defined, crystallized and used in conscious policy. America for many reasons seems called upon to find and apply the meaning of democracy. The fundamental concept has always been more or less in

the background of American consciousness. If in the future it becomes a determining map for our guidance and the guidance of others, many concrete problems will have to be decided. Yet within the four corners of a clear-cut understanding of democracy these economic, social, cultural, international, and racial problems will inevitably fit into the total pattern.

The direction of social change and the nature of the solution of our problems are not matters of grave concern so long as we keep perfectly straight in regards to democracy. The danger is that we may fail, at this critical stage, to clarify our concept of the meaning of that word. Any pessimism which may be aroused by the present situation is due to the fear that our citizenry may not be intelligent enough and educated enough to work out the definition of democracy. This is the problem of our age. This should be the problem of all our educational agencies, school, churches, radio, and press. We should feel that as yet we haven't begun to fight. The so-called challenge to democracy should kindle in our minds a joyous optimism for at last it seems the issue is becoming clean-cut. *Experiments in government, international turmoil, new economic and social orders all have cut away the obscuring ideas of nationalism, internationalism, economic determinism, parliamentarism, middle class industrialism, proletariate upsidedownism, imperialism, etc. They have led us to see clearly that the great problem is one of democratic living.* All else is secondary and can find a solution easily when we come to learn a little more about this thing called democracy.

As a possible illustration of this point we have only to turn to the tremendous burden of increasing armaments and the actual state of war existing in Spain and the Orient. Now it is perfectly clear that war exists and more general war is just ahead, and yet it is equally certain that the peoples of the world do not want war. The more insane in this war mania the governments of various nations become the more certain it is that the peoples of the world will seek a closer definition and a practical application of democracy.

In aiding in this great task the author has two suggestions to make. First, let us re-examine closely our own history. Let us realize that conditions in our national evolution were very favorable to democratic living and therefore complications which tend to obscure the picture were not present. Let us see how the successive American frontiers tested and retested democracy and each added its increment to the interpretation. Let us examine more carefully the meaning of the Declaration of Independence, the Constitution of the United States, and the Northwest Ordinance. Let us try to get a little closer to the real contributions of Jefferson, Jackson, and Lincoln. Let us do this critically and in no spirit of worship of the past, but for the purpose of finding out the significance of America as a land of the free. I believe that there is entirely too much of the feeling that we cut all connections with the past with the coming of the great depression and that we face today an uncharted sea. Such is far from the facts. The chain of historical continuity and causation has not been broken and after the storm

we get our bearing by noting the path over which we have sailed and the total direction of the voyage.

In the next place, let us have faith in and strive to improve our public schools. Their concept is the best example I know of the democratic pattern. Here individuals from all races, creeds, and economic and social classes meet on terms of equality for the purpose of educating themselves and one another. The individual is not submerged in the group and the group is not sacrificed to the individual. The group plans and moves forward through the efforts of individuals by means of coöperation for a common purpose. Here, if anywhere, democracy can prevail and it must prevail if we are to discover and apply its full connotation. Let us, as good citizens, see to it that the highest degree of intelligence goes into the teaching and administrative staffs and that the school is perfectly conscious of its mission on behalf of democracy. Let it train critical intelligences keen enough to filter the complex social scene by standards found by an analysis of the fundamental philosophy of democracy.

Much has been written on the subject of democracy and education, but even yet the public does not seem conscious of the opportunity and duty of the schools in this matter. The schools must make democracy meaningful by working out its definition, first, by tracing its evolution from our own national experiences and, secondly, by the full development of democratic living within the school itself. The underlying philosophy of the curriculum should be democracy, and all educational objectives should be stated in terms of elements of democratic living.

The recognition of change and rapid rate of change is in no sense the primary consideration in planning the work of our schools. This emphasis on the shifting and elusive nature of the target doesn't seem to be helping the steadiness of our aim. Our vaunted pragmatism becomes little more than a sense of futility. We have heard the phrase "educating for a changing world" so frequently that we have about come to the notion that anarchy in the schoolroom is about as safe a guess as any as to the probable future which the child will face. In order to cut loose from formalism we have sometimes taken a strange view of the past. We expect the child to learn through meaningful experiences and yet we are willing to junk what the race has learned in the same manner. If our education is not meeting the needs of today, let us not too rashly assume that we will have to arrive at a totally new set of principles and objectives of American life before we can get our schools on the right track. Let us attend to our own business—the business of America—that is the definition, application, and promotion of democracy. Let us look upon tradition not as something that limits and binds, but as something that illuminates and orients.

Quite recently I heard two discussion groups, each of which seemed to me to be missing the fundamentals of the task of modern education. The one group was composed largely of leaders in education drawn from university, state department, and public school administrators. They were concerned in curriculum revision. There was much talk about new materials,

new philosophy, new areas, and new social order. The word democracy was often used, but it seemed to be something that they were going to create out of whole cloth. Instead of being the subject it was a loosely used adjective. Instead of being an objective it was mere coloring. There was no attempt to estimate the solid achievements of democracy as an American theory of life, and no attempt to formulate a definition of democracy. Its functions in curriculum building cannot be implied. They must be consciously and constructively used as a frame of reference and as an orienting and focalizing instrument. In short, groups of educationists often lack a constructive tie-up with the lessons of American history.

The second group meeting was composed of college teachers of history. The keynote of their talk was, "Let us keep history undefiled by any contacts with education." It was quite clear that this group did not favor any attempt by trained historians to make any generalizations or conclusions in regard to the nature and meaning of American democracy. They could see the rashness of the educationists, but they could not or would not see their own responsibility in making history of real use to the children of our nation and their teachers. All of our experts who have knowledge and insight into the true definition of American democracy must coöperate with those who teach our children. To dodge this obligation is to fail to participate in democratic living.

Would it not be a good idea for all of our agencies which have an influence on what is done in the name of education to concentrate on the relatively simple job of squaring the whole business with what we now know about democracy. And, in addition, put all those minds which are so seriously concerned about the present and future of our schools to work on the task of further research in the clarification of the meaning of democracy in terms of concrete guiding principles.

DEPARTMENT OF BOOK REVIEWS

Third Digest of Investigations in the Teaching of Science. By *Francis D. Curtis.* xviii, 419 pp. 1939. $3.50. P. Blakiston's Son & Co., Philadelphia.

The hearts of 93 studies, completed from 1931 through 1937, published and unpublished, concerning science instruction on the elementary, high school, and college levels. This third volume brings the total number of studies digested to 257.

These digests are of value to researchers because of techniques described, to supervisors for the conclusions they present, to curriculum committees for the trends they indicate, and to classroom teachers for the interesting experiments they suggest.

The author's breadth of educational interest is seen in the selection of the studies, his literary skill in their digesting, his modesty in the scant attention he has given to his own scholarly investigations.

* * *

Biology. By *Truman J. Moon*, Head of Science Department, High School, Middletown, N. Y., and *Paul B. Mann*, Head of Department of Biology, Evander Childs High School, New York City. Henry Holt and Co., N. Y. 866 pages. Second edition. 1938. $2.00.

This is one book concerning which no accompanying leaflet from either publisher or authors expresses words of special praise. No profuse verbiage of commendation makes one suspicious of an attempt to force a book upon the market or upon the schools of the country. The book is sent forth to reviewers with the evident purpose of letting it speak for itself. This it does very well.

In this very substantial volume—perhaps a bit heavy to hold in one's hand for a long period of study—the capable authors present ten units of biological study and research. Each unit is divided into several chapters, and each chapter has well-emphasized paragraphs with many appropriate and clarifying illustrations. The reviewer turns, almost at random, to a chapter on "Germination." In this chapter many facts are given concerning seeds, the food stored in them, the natural digestion of the stored food, conditions and results of germination, and a brief study of the incipient root-system. At the close of this chapter (as in all the other chapters) is given a series of suggestive and stimulating questions. Reference is made to several books for collateral reading, and two very practical suggestions are made for the guidance and experimentation of both teacher and pupils. Finally, there is a list of words for special study. So the book continues, throughout its many pages, in a long series of studies, experiments, research problems and important facts. It is a practical book for teachers of Biology in any high school or other secondary school.

One of the best recommendations is to be found in the fact that this is the second edition of a much-used textbook. Evidently there was a demand for this new edition.—EARLE A. BROOKS, Associate Professor of Biology, Boston University School of Education.

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Methods and Materials for Teaching Biological Sciences. By *David F. Miller* and *Glenn W. Blaydes.* xii, 435 pp. 1938. $3.50. McGraw-Hill Book Co., New York.

A comprehensive volume offering six chapters of principles, four of general methods, and thirteen of hearteningly specific instructions for preparation and use of materials in the classroom. These directions feature resourcefulness in collecting, care in preserving, and cleverness in an amazing number of demonstrations with common home or laboratory apparatus.

Liberal diagrams and pen drawings make the book clear, and comprehensive bibliographies enlarge its usefulness.